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Air

Economic Impact Analysis for the Brick and Structural Clay Products Manufacturing NESHAP: Final Rule

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U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Innovative Strategies and Economics Group, MD-C339-01
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Acronyms

BSCP	Brick and Structural Clay Products
CAA	Clean Air Act
DIFF	Dry Injection Fabric Filter
EIA	Economic Impact Analysis
EPA	United States Environmental Protection Agency
HAPs	Hazardous Air Pollutants
HCl	Hydrogen Chloride (also known as Hydrochloric Acid)
HF	Hydrogen Fluoride
ISEG	Innovative Strategies and Economics Group
MACT	Maximum Achievable Control Technology
MRR	Monitoring, Recordkeeping, and Recording
NAICS	North American Industry Classification System
NESHAP	National Emission Standards for Hazardous Air Pollutants
OAQPS	Office of Air Quality Planning and Standards
O&M	Operating and Maintenance

RFA	Regulatory Flexibility Act
SBE	Standard Brick Equivalent
SBREFA	Small Business Regulatory Enforcement Fairness Act
SIC	Standard Industrial Classification
TAC	Total Annual Costs
VOS	Value of Shipments

ECONOMIC IMPACT ANALYSIS:

BRICK AND STRUCTURAL CLAY PRODUCTS

1 INTRODUCTION

Pursuant to Section 112 of the Clean Air Act, the U.S. Environmental Protection Agency (EPA or the Agency) is developing National Emissions Standards for Hazardous Air Pollutants (NESHAPs) to control emissions released from the domestic production of bricks and structural clay products (BSCP). Production of BSCP entails the firing of shaped clay minerals in kilns, a process that results in emissions of hazardous air pollutants (HAPs). The NESHAP which this economic impact analysis (EIA) addresses is scheduled to be proposed in mid-2001. The Innovative Strategies and Economics Group (ISEG) of the Office of Air Quality Planning and Standards (OAQPS) has developed this analysis in support of the evaluation of impacts associated with the BSCP manufacturing NESHAP.

1.1 Scope and Purpose

This report evaluates the economic impacts of pollution control requirements on BSCP operations. The Clean Air Act (CAA) was designed to protect and enhance the quality of the nation's air resources and Section 112 of the CAA establishes the authority to control HAP emissions. A large percentage of the HAP compounds released from BSCP facilities are hydrogen fluoride (HF) and hydrochloric acid (HCl). To reduce emissions of these HAPs and other HAP metals, the Agency establishes maximum achievable control technology (MACT) standards. The term "MACT floor" refers to the minimum control technology on which MACT standards can be based. The MACT floor is set by the average emissions limitation achieved by the best performing 12 percent of sources in a category or subcategory when that category or subcategory contains at least 30 sources. The estimated costs for individual BSCP facilities to comply with these standards are inputs to the economic impact analysis presented in this report.

1.2 Organization of the Report

The economic impact analysis is organized into four sections. Section 2 provides a profile of the industry which includes a description of the producers and consumers of BSCP. This section also presents available market data and trends in the industry, including domestic production, foreign trade, and apparent U.S. consumption. Section 3 describes the facility-level costs of complying with this NESHAP and Section 4 provides facility-, market-, and society-level impacts of complying with this rule. Small business considerations are made in Section 5 as required by the Regulatory Flexibility Act (RFA) which was modified by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA).

2 INDUSTRY PROFILE

The industry profile is organized as follows: Section 2.1 describes the processes and costs of producing BSCP, as well as the types of emissions released during production. Section 2.2 explains the various uses, consumers, and substitute products available for BSCP. Section 2.3 provides a summary profile of the BSCP industry, including a description of the manufacturing facilities and the companies that own them.

Bricks and structural clay products are among the most commonly used materials in the construction of homes and buildings. These products are durable, weather-resistant, and fireproof, thereby making them suitable for use in construction (Brick Industry Association, 1999). Bricks are cemented together to erect the walls of buildings while other structural clay products are used in various building applications. For example, clay pipe, structural clay tile, and drain, sewer, and roofing tile, are used in plumbing systems and roofing applications.

BSCP manufacturing falls under the following Standard Industrial Classification (SIC) codes:

- **SIC 3251**, Brick and Structural Clay Tile; and

- **SIC 3259**, Structural Clay Products, not elsewhere classified (n.e.c).

These correspond to the following North American Industrial Classification System (NAICS) codes:

- **NAICS 327121**, Brick and Structural Clay Tile Manufacturing; and
- **NAICS 327123**, Other Structural Clay Products Manufacturing.

Production of bricks and structural clay products follows a similar process. Regardless of the structural clay product being produced, the production process results in HAP emissions. The primary HAPs emitted are hydrogen fluoride (HF) and hydrogen chloride (HCl) and the major source of these emissions are kilns used to fire BSCP.

2.1. Production Overview

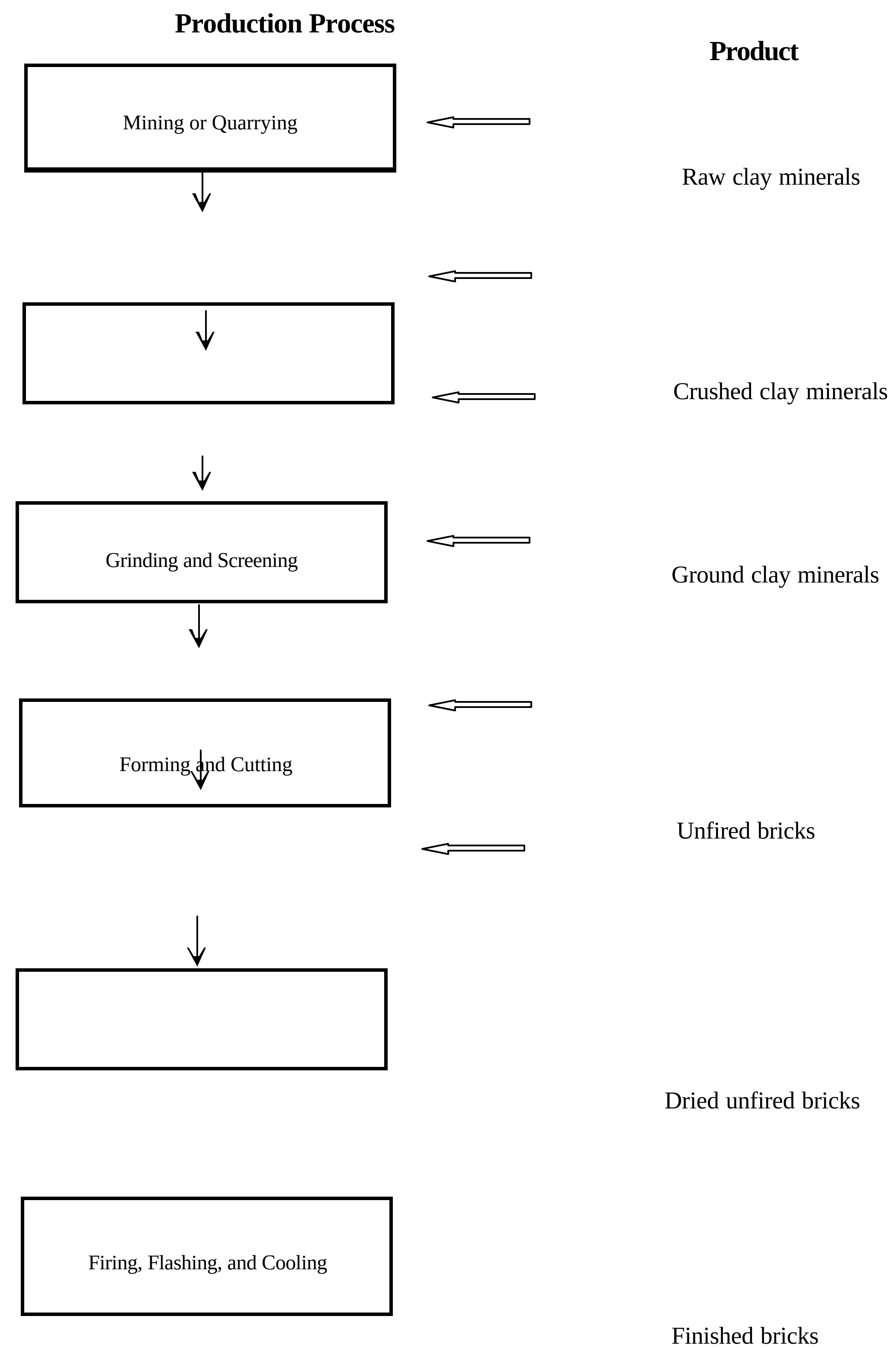
This section provides a description of the production of BSCP. Section 2.1.1 provides an overview of the stages of production, while Section 2.1.2 briefly describes the emissions released as BSCP are produced. Section 2.1.3 addresses the costs of producing BSCP and last, Section 2.1.4 provides average values of the types of clay minerals used in the production of BSCP.

2.1.1 Stages of Production

As shown in Figure 2-1, there are several steps involved in the production of BSCP. Clay minerals, the primary raw materials used in BSCP manufacturing, must first be mined. The mined materials are then:

- **prepared** through crushing, grinding, and screening;
- **shaped** into BSCP through forming and cutting;
- **dried** in dryers;
- **fired** in tunnel or periodic kilns; and then
- **cooled** prior to packaging and shipping[1].

[1]Of these stages of production, only the firing stage is impacted by the NESHAP.



Production Process
Product
Mining or Quarrying
Raw clay minerals
Crushed clay minerals
Grinding and Screening
Ground clay minerals
Forming and Cutting
Unfired bricks
Dried unfired bricks
Firing, Flashing, and Cooling
Finished bricks

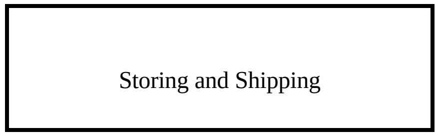


Figure 2-1. Brick and Structural Clay Products Manufacturing Process

Source: U.S. Environmental Protection Agency. 1997. *Emission Factor Documentation for AP-42, Section 11.3,* "Brick and Structural Clay Products Manufacturing: Final Report."

A detailed discussion of the production process below focuses on brick manufacturing, as structural clay products typically are produced in a similar manner. The primary difference in the production processes of bricks and structural clay products is how the prepared clay minerals are shaped and sized. Information in this section was taken from EPA's Emission Factor Documentation on Brick and Structural Clay Products Manufacturing (1997).

Production of brick begins with the mining of raw material, such as common clay and shale. This is the most common type of clay used in the production of BSCP. Producers of BSCP acquire their raw material either by mining it themselves or by purchasing it from local mineral processing plants. Often, a company owns a mining pit as well as facilities at which BSCP are produced. After the material is mined or purchased, it is fed into a crusher for initial size reduction. The material next passes through grinders to produce a finely ground material. This product is then screened for size and oversized material is returned to the grinders. The finely ground material is next conveyed to the mill room where it is formed into bricks.

The following processes exist to shape bricks:

- stiff mud extrusion,
- soft mud press process, and
- dry press process.

Most brick is formed through the stiff mud extrusion process. This process begins with the use of a pug mill. In the mill, finely ground clay minerals are mixed with water and are then transferred into a vacuum chamber. Producers at this point can introduce additives, such as barium carbonate, to prevent sulfates present in the clay minerals from rising to the surface of the bricks. Next, air is removed from the material in the chamber, and the material is extruded through dies. Surface treatments can be introduced at this point to add specific color or texture to the product. Some of these surface treatments include manganese dioxide, iron oxide, and iron chromite. The extruded column of material is then cut into individual bricks using a wire-cutting machine. The bricks are set onto kiln cars and proceed to the dryers, which are typically heated to 204 degrees Celsius.

The soft mud process is used to produce bricks when clay is too wet for extrusion. In this process, finely ground clay minerals are blended with water and then formed into bricks using molds. The bricks are dried before proceeding to the kilns. In the dry press process, clay is mixed with a small amount of water and steel molds are used to shape the individual bricks. Pressure of 500 to 1,500 pounds per square inch is then applied to the molds to bond the material into bricks. These bricks then proceed to the dryers.

From the dryer, the bricks enter the kiln for firing. There are several steps to firing the bricks in the kiln. These steps are the evaporation of free water, dehydration, oxidization, vitrification, and flashing. Flashing refers to the process of introducing uncombusted fuel into the kiln atmosphere in order to add color to the surface of the bricks. Most kilns are fired with natural gas, although coal, sawdust, fuel oil, and landfill gas are also used. Once the bricks have been fired, they are then cooled to ambient temperatures before they leave the kiln. This completes the process of brick manufacturing.

2.1.2 Emissions from the Brick and Structural Clay Product Facilities

Production of BSCP requires a number of steps that result in the emissions of HAPs and other pollutants. These pollutants include particulate matter (PM), sulfur dioxide (SO_2), nitrogen oxides (NO_x), carbon monoxide (CO), carbon dioxide (CO_2), volatile organic compounds (VOCs), and HAPs including HCl, HF, and HAP metals. The grinding and screening operations and kilns emit PM emissions. Kiln fuel combustion and some dryer combustion also result in emissions of SO_x, NO_x, CO, and CO_2. However, the primary source of SO_2 emissions from the kilns is the raw material, which contains sulfur compounds. These sulfur compounds form SO_2 when the raw material is fired. Similarly, the kilns release HF and HCl due to the presence of fluoride and chloride compounds in the raw material.

2.1.3 Costs of Production

This section discusses the costs of producing BSCP. There are several types of production costs such as:

- **capital expenditures**, including the costs of equipment and its installation;
- **energy costs**, which are the costs of electricity and fuels used in the production of BSCP;
- **labor costs**, including the costs associated with employees wages and benefits; and
- **the cost of materials**, which are the costs of tangible inputs such as clay minerals, parts, and additives.

Tables 2-1 and 2-2 show the historical production cost data for the brick and structural clay tile industry (SIC 3251) and the other structural clay product industry (SIC 3259) that were gathered from the U.S. Census Bureau.

Table 2-1. Production Costs for the Brick and Structural Clay Tile Industry (SIC 3251) ($$10^6$)

Year	Labor Costs	Material Costs	Energy Costs	Capital Expenditures	Value of Shipments
1992	$213.9	$229.5	$142.7	$42.9	$1,116.0
1993	$229.3	$280.0	$157.3	$56.1	$1,199.1
1994	$233.9	$312.2	$151.2	$63.8	$1,319.1
1995	$235.2	$300.8	$139.8	$77.1	$1,283.3
1996	$246.7	$304.0	$160.3	$132.9	$1,421.9
1997	$262.2	$282.0	$175.6	$72.1	$1,452.2
Avg.	$236.9	$288.0	$154.5	$74.2	$1,298.6

Source: U.S. Department of Commerce, Bureau of the Census. 1999. *1997 Economic Census, Manufacturing Industry Series*, "Brick and Structural Clay Tile Manufacturing."

U.S. Department of Commerce, Bureau of the Census. 1998. *1996 Annual Survey of Manufactures*, M96(AS)-1 Statistics for Industry Groups and Industries.

U.S. Department of Commerce, Bureau of the Census. 1996. *1994 Annual Survey of Manufactures*, M94(AS)-1 Statistics for Industry Groups and Industries.

U.S. Department of Commerce, Bureau of the Census. 1995. *1993 Annual Survey of Manufactures*, M93(AS)-1 Statistics for Industry Groups and Industries.

Similar trends can be seen in the production costs across both SIC codes. For both the brick and structural clay tile industry (SIC 3251) and the other structural clay products industry (SIC 3259), the cost of materials accounts for the largest share of the value of shipments (VOS). For SIC 3251, cost of materials were equal to about $288 million on average, or 22 percent of the brick and structural clay tile industry's (SIC 3251) VOS. For SIC 3259, material costs on average were almost $38 million, or 27 percent of the industry's (SIC 3259) VOS. Labor costs represent the next largest share of the VOS for both markets, approximately 20 percent, and energy costs are approximately 11 percent of their VOS. Capital expenditures represent the smallest share of VOS for both SIC 3251 and SIC 3259.

Table 2-2. Production Costs for the Other Structural Clay Products Industry (SIC 3259) ($$10^6$)

Year	Labor Costs	Material Costs	Energy Costs	Capital Expenditures	Value of Shipments
1992	$23.5	$34.3	$15.0	$5.4	$125.8
1993	$25.2	$30.6	$17.0	$6.8	$118.3
1994	$28.7	$41.5	$15.5	$4.0	$142.1
1995	$29.7	$43.2	$16.3	$4.4	$150.4
1996	$37.6	$52.3	$21.7	$4.2	$177.5
1997	$22.9	$25.9	$8.9	$4.9	$118.3
Avg.	$28.0	$38.0	$15.7	$5.0	$138.7

Source: U.S. Department of Commerce, Bureau of the Census. 1999. *1997 Economic Census, Manufacturing Industry Series*, "Other Structural Clay Product Manufacturing."

U.S. Department of Commerce, Bureau of the Census. *1996 Annual Survey of Manufactures*, M96(AS)-1 Statistics for Industry Groups and Industries.

U.S. Department of Commerce, Bureau of the Census. *1994 Annual Survey of Manufactures*, M94(AS)-1 Statistics for Industry Groups and Industries.

U.S. Department of Commerce, Bureau of the Census. *1993 Annual Survey of Manufactures*, M93(AS)-1 Statistics for Industry Groups and Industries.

Upon examination of both tables, the data clearly show that the size of the brick and structural clay tile industry is much larger than the other structural clay products industry. In fact, the value of shipments for the brick and structural tile industry (SIC 3251) is almost ten times greater than the value of shipments for the other structural clay products industry (SIC 3259).

2.1.4 Value of Clay Minerals

The most common raw materials used to produce BSCP are common clay and shale. Fire clay, kaolin, and other materials are also used, but to a lesser degree. The average value per metric ton of common clay and shale over the years 1993 to 1997 was $5.64. For fire clay, the average value over the same time period was $21.64 and for kaolin, it was $114.42. Based on the differences in the average values across these clay types, it is clear why common clay and shale would be used as an input since it is suitable for BSCP. It is a relatively cheaper input that possesses the necessary attributes to produce BSCP.

Table 2-3 shows the difference in values of common clay and shale, fire clay, and kaolin produced and sold in the U.S. for the years 1993 through 1997. The production-weighted average price for clay minerals used in BSCP is also derived. Since the weighted average prices are relatively low, it is clear that common clay and shale is more heavily relied upon relative to fire clay and kaolin for production of BSCP. In fact, on average over this time period, 98 percent of the clay minerals used in BSCP were common clay and shale (Virta, 1999).

Table 2-3. Price Value of Clay Minerals Used in BSCP: 1993 - 1997 ($/metric ton)

Clay Minerals	1993	1994	1995	1996	1997	Avg.
Common Clay & Shale	$5.42	$5.31	$5.90	$5.50	$6.08	$5.64
Fire Clay	$25.05	$25.44	$21.96	$21.19	$14.56	$21.64
Kaolin	$108.38	$116.31	$117.09	$119.83	$110.52	$114.42
Weighted Average[a]	$7.23	$6.97	$7.82	$7.34	$6.47[b]	$6.97

Notes: [a]Weighted average reflects the production-weighted prices for clay minerals used to produce BSCP.

[b]Production-weighted average price for the year 1997 does not include fire clay because quantity of this clay mineral used in BSCP was not available for this year.

Source: Virta, Robert. 1999. "Clays," *In: Minerals Yearbook, Metals and Minerals 1997: Volume 1.* U.S. Geological Survey. U.S. Government Printing Office.

Virta, Robert. 1998. "Clays," *In: Minerals Yearbook, Metals and Minerals 1996: Volume 1.* U.S. Geological Survey. U.S. Government Printing Office.

Virta, Robert. 1997. "Clays," *In: Minerals Yearbook, Metals and Minerals 1995: Volume 1.* U.S. Geological Survey. U.S. Government Printing Office.

Virta, Robert. 1996. "Clays," *In: Minerals Yearbook, Metals and Minerals 1994: Volume 1.*

U.S. Geological Survey. U.S. Government Printing Office.

The value of common clay and shale remained relatively constant, although it did reach a peak price of $6.08 per metric ton in 1997. Contrary to the behavior of the value of common clay and shale, both fire clay and kaolin sharply dropped in value in 1997. In fact, fire clay shows a general declining trend over the years 1993 to 1997 while kaolin steadily increased in value until it reached a peak of $119.83 in 1996. It then sharply fell in value in 1997.

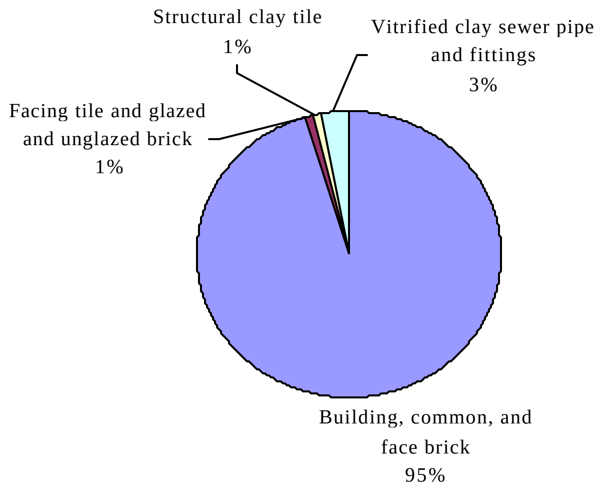
2.2 Uses, Consumers, and Substitutes

Clay minerals are the main input used to produce BSCP. These products are then used by the construction industry to build several different types of structures, including homes, buildings, and office facilities. The following section describes the uses, consumers, and substitutes of BSCP. In Section 2.2.1, the various uses for BSCP are described. Section 2.2.2 identifies the intermediate and final consumers of bricks and structural clay products. Last, the different products that can act as substitutes for bricks and structural products are described in Section 2.2.3.

2.2.1 Uses of Brick and Structural Clay Products

Bricks and structural clay products are used as inputs to the production of buildings, homes, and structures. Building, face, and common bricks are used to erect the walls of structures, while glazed bricks are used for flooring. Other structural clay products, such as clay pipe, structural clay tile, chimney pipe, flue linings, and drain, sewer, and roof tile are used in the installation of plumbing systems, fireplaces, and roofs. Brick and structural clay products have a variety of characteristics desirable in building materials. They are durable, resistant to fire, weather, and pests, and require little maintenance. Use of bricks enhances the resale value of homes and is considered energy efficient since they absorb heat and slow down heat transfer. In the summer a brick exterior retards the absorption of heat and in the winter, the exterior retains heat indoors (Brick Industry Association, 1999).

Census Data provide the 1997 values of select BSCP produced by SICs 3251 and 3259. As Figure 2-2 shows, the value of common, building, and face brick represents 95 percent ($1.34 billion) of the value of shipments for selected products in the brick, structural clay tile, and structural clay products industries. The rest of the end uses represented here, facing tile, glazed and unglazed brick, structural clay tile, and vitrified clay sewer pipe and fittings, together comprise only 5 percent of the value of shipments. This distribution is perhaps explained by the fact that there are a number of less expensive



1997 Value of Shipments = $1.41 Billion

Figure 2-2. Distribution of BSCP Shipments by End Use: 1997

Source: U.S. Department of Commerce, Bureau of the Census. 1998. *Current Industrial Reports for Clay Construction Products - Summary 1997.*

products that compete with structural clay products, such as concrete and PVC pipes and asphalt roofing materials. Structural clay products are, for the most part, specialty items in many parts of the country. It is important to note that the above pie chart represents *selected* BSCP in both SICs 3251 and 3259. The value of shipments of these products, $1.41 billion, is therefore less than the sum of the value of shipments for the entire BSCP industry ($1.57 billion).

2.2.2 Consumers of Brick and Structural Clay Products

The immediate purchasers of these products are construction companies who use them as inputs to the production of homes, buildings, and structures. Construction companies or contractors may also buy these products to specifically install plumbing systems, fireplaces, and new roofs and floors to existing structures. Consumers then purchase the homes, structures, and buildings produced by construction companies, or they hire contractors to make improvements to existing structures using structural clay products. These consumers therefore have an indirect demand for BSCP. However, if they build homes or make improvements themselves, then consumers directly demand these products.

2.2.3 Substitutes for Brick and Structural Clay Products

Aside from brick, there are a number of alternative building materials that can be used for the exterior walls of buildings, homes, and structures. Common alternatives are stucco, wood, hardboard, and aluminum and vinyl siding. There are certain advantages and disadvantages to using these materials instead of brick.

Stucco is made from sand, Portland cement, and water and is extremely durable. It is applied in three coats with pigment mixed in so that painting is not necessary. While stucco can create an extremely strong and long-lasting exterior, it can be difficult to apply and is subject to cracking if applied incorrectly. Wood is the oldest siding material used to build exterior walls for homes and buildings. It comes in a variety of forms including shingles, panels, and natural logs. When used for exterior walls, wood can be left as is, or can be painted over therefore offering flexibility in its appearance. It is organic which makes it an attractive option, however exposure to severe weather can result in wood rot and decay. In addition, wood is vulnerable to pests, such as termites, that can damage the structure of homes. Hardboard is a wood composite made by mixing wood fiber and a natural or chemical binder and pressing the mixture into panels or lap siding. Hardboard siding is coated with a water resistant primer and is painted. Aluminum and vinyl siding are simple exterior materials to care for, as they are nailed to the exterior of structures. These sidings do not need to be painted and can be easily cleaned by washing with water (Better Business Bureau, 2000).

There are also alternatives to roofing tiles and glazed brick for roofing and flooring applications. Roofing tile is one option for roofing, however wood shingles, asphalt, and metal can also be used. One of the characteristics common to roofing tile, asphalt, and metal is that they are all fireproof. Wood shingles are not as common as they once were because they do not possess this quality. Alternatives to clay tiles for flooring are wood, marble, vinyl, and linoleum. These options vary by price, quality, and appearance. Marble, clay tile, and hardwood floors are relatively sturdy, and therefore more expensive than vinyl and linoleum.

2.3 Industry Organization

This report addresses the economic impacts of pollution control requirements on facilities that produce bricks and structural clay products. Because there are costs associated with the control of HAPs, it is important to determine how the industry may be affected. This section provides a description of the industry's organization at both the facility-level and company-level. Section 2.3.1 first provides an overview of the market structure of the BSCP manufacturing industry. Section 2.3.2 characterizes the manufacturing facilities in this industry, while the parent companies of these facilities are described in Section 2.3.3. Last, Section 2.3.4 provides data on domestic production, foreign trade, and apparent consumption of bricks and structural clay products.

2.3.1 Market Structure

Market structure is of interest because it determines the behavior of producers and consumers in the industry. In perfectly competitive industries, no producer or consumer is able to influence the price of the product sold. In addition, producers are unable to affect the price of inputs purchased for use in production. This condition is most likely to hold if the industry has a large number of buyers and sellers, the products sold and inputs used in production are homogeneous, and entry and exit of firms is unrestricted. Entry and exit of firms are unrestricted for most industries, except in cases where the government regulates who is able to produce output, where one firm holds a patent on a product, where one firm owns the entire stock of a critical input, or where a single firm is able to supply the entire market. In industries that are not perfectly competitive, producer and/or consumer behavior can have an effect on price.

Concentration ratios (CRs) and the Herfindahl-Hirschman index (HHIs) can provide some insight into the competitiveness of an industry. The U.S. Department of Commerce reports these ratios and indices for the four-digit SIC code level for 1992, the most recent year available. Table 2-4 provides the four- and eight-firm concentration ratios (CR4 and CR8, respectively), and the Herfindahl-Hirschman index for both the brick and structural clay tile industry (SIC 3251) and for the other structural clay products industry (SIC 3259). For SIC 3251, the CR4 was 34 percent, and the CR8 was 52 percent. For SIC 3259, the CR4 was 35 percent and the CR8 was 60 percent.

The criteria for evaluating the HHIs are based on the 1992 Department of Justice's Horizontal Merger Guidelines. According to these criteria, industries with HHIs below 1,000 are considered unconcentrated (i.e., more competitive), those with HHIs between 1,000 and 1,800 are considered moderately concentrated (i.e., moderately competitive), and those with HHIs above 1,800 are considered highly concentrated (i.e., less competitive). In general, firms in less concentrated industries are more likely to be price takers, while those in more concentrated industries have more ability to influence market prices. Based on these criteria, both the brick and structural clay tile industry and the other structural clay products industry can be modeled as perfectly competitive for the purpose of this EIA.

Table 2-4. Market Concentration Measures for the Brick and Structural Clay Tile Industry (SIC 3251) and the Other Structural Clay Products Industry (SIC 3259)

SIC Code	Value of Shipments ($\$10^6$)	CR4	CR8	HHI
3251	$1,452.19	34%	52%	433
3259	$118.35	35%	60%	560

Note: CR4 and CR8 are the concentration ratios of the top 4 and 8 firms in the industry (by sales), respectively. HHI refers to the Herfindahl-Hirschman Index which is the sum of squared market shares for each company in a given industry.

Source: U.S. Department of Commerce, Bureau of the Census. 1999. *1992 Concentration Ratios in Manufacturing*. <http://www.census.gov/epcd/www/concentration.html>.

2.3.2 Manufacturing Facilities

As of 1996, there were 189 facilities producing bricks and structural clay products in the United States. Of these facilities, 164 were brick producers, 19 were structural clay product producers, and 6 produce both product types. Regardless of the type of product the facility produces, it can be classified as either one of two types of producers: a non-integrated producer or an integrated producer. Non-integrated BSCP producers purchase clay mineral inputs to use in production and then complete the manufacture of the final products. Integrated producers of BSCP are vertically integrated, which means they mine their own clay mineral inputs to use in the production of their final products.

The size of facilities depends on whether they are non-integrated or integrated producers. Plants that perform their own mining operations tend to be larger in size than those that purchase their inputs from a minerals processing plant. Even if facilities are non-integrated producers, it is likely that they are located near sources of clay minerals so that the transportation cost of this essential input remains low. Thus the locations of the 189 facilities are determined by the location of common clay and shale deposits. These facilities are located across 39 states with the highest concentrations in Ohio, with 22 facilities, North Carolina with 20 facilities, Texas with 18 facilities, and Alabama with 11 facilities (see Figure 2-3).

2.3.3 Firm Characteristics

The Agency identified 90 ultimate parent companies that owned and operated the 189 potentially affected facilities within this source category during 1996. Sales and employment data were obtained for these owning entities from either their survey response or one of the following secondary sources:

- American Business Directory (American Business Information, 1999),
- Dun & Bradstreet Market Identifiers (Dun & Bradstreet, 1999),
- Gale Group Company Intelligence (Gale Group, 1999),
- Hoover's Online (Hoover's, 2001),
- The Handbook of Texas Online (1999), or
- Standard & Poor's Register-Corporate (Standard & Poor's Corp., 1998)

Appendix A provides a listing of the companies identified by the Agency that own the potentially affected facilities within this source category.

Annual sales and employment data were available for 86 of the 90 companies (96 percent). The average (median) sales of companies reporting data were $124.5 million ($8.0 million). This includes revenue from operations other than BSCP manufacturing. The average (median) employment for these companies was 987 (92) workers. As of 1998, the top four companies in annual sales are:

- Hanson, PLC - $3.0 billion with 27,000 employees,
- Certainteed Corporation - $1.6 billion with 6,950 employees,
- Wienerberger Baustoffindustrie AG - $1.5 billion with 10,370 employees, and
- Texas Industries, Incorporated - $1.2 billion with 4,100 employees.

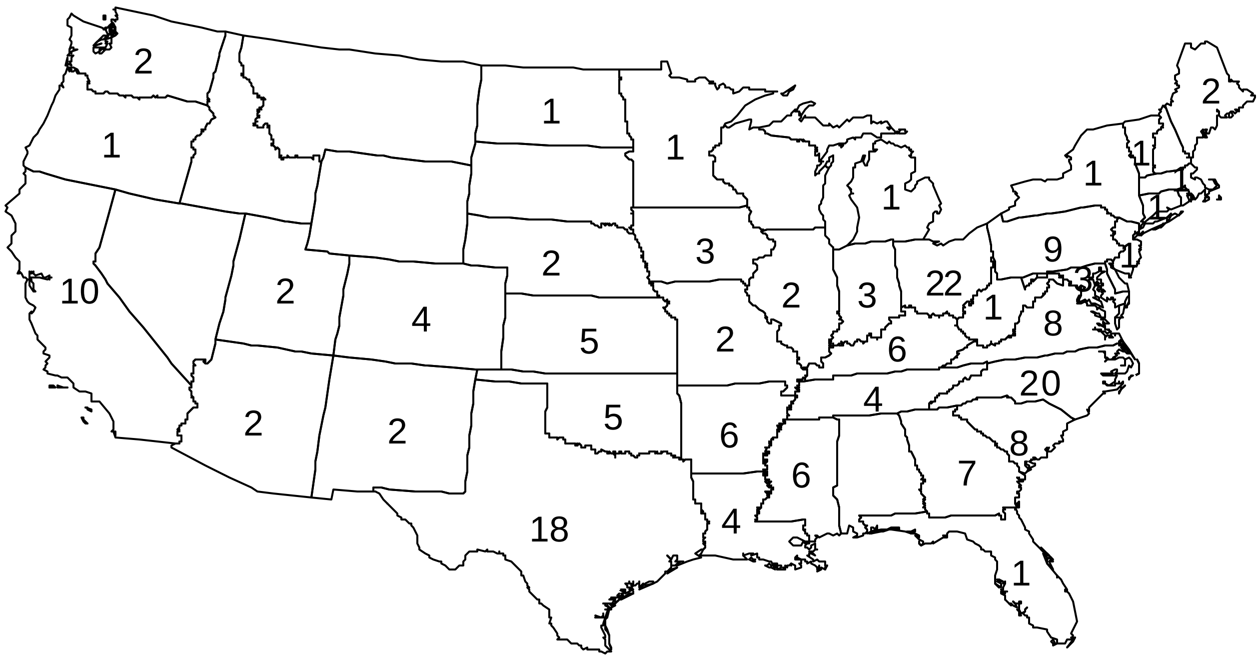


Figure 2-3. Location of Brick and Structural Clay Product Facilities

2.3.4 Small Business Annual Sales

EIA estimated revenues derived from company survey responses were used to represent annual sales for small businesses when these estimated revenues were greater than the annual sales reported in publicly available company profiles, or when annual sales figures were not available[2]. By definition, company sales are at least equal to the sum of the revenues generated at its facilities. Therefore, in the cases where annual sales were less than the EIA estimated revenues for the small firms, EPA chose to rely upon revenue estimates based on company survey responses. Sales may be under-reported in the secondary sources listed above because they represent the annual sales of a subsidiary or branch of a company or because these providing organizations generated their sales estimates. Additionally, relying on estimated revenues instead of potentially under-reported company sales data makes consistent the results across the facility-level economic impacts model (in Section 4) and the small business cost-to-sales ratio screening analysis (in Section 5). Of the 77 small businesses, 36 had estimated revenues in excess of their publicly available sales data and an additional 3 small companies had no available sales data. Table 2-5 provides comparative statistics on company sales and their estimated revenues for this subset of small companies.

Table 2-5. Summary Statistics for Small Company Sales Data: 1999

	Publicly Reported Sales ($\$10^6$/yr)	EIA Estimated Revenues ($\$10^6$/yr)
Companies (#)	36	39
Average	5.7	10.0
Median	4.2	6.1
Minimum	1.0	1.1
Maximum	22.0	48.2

Note: The summary statistics calculated for annual sales from publicly available sources excludes three companies that were included in the summary statistics for annual estimated revenues because no annual sales data were reported.

2 Company revenues were estimated by multiplying baseline price by reported production totals of their brick and structural clay product facilities.

Table 2-6 presents a frequency distribution of the discrepancy between annual sales and estimated annual revenues for the small companies with identified data discrepancies. It is clear that for a large share of these firms, the discrepancy between reported sales and EIA estimated revenues are rather large. In fact, over 35 percent of the 36 companies have estimated revenues that are over 100 percent greater than the reported annual sales. The magnitude of the discrepancy supports a replacement of the annual sales data with EIA estimated annual revenues, at least for the small companies, whose sole business it is to produce and sell brick and structural clay products.

Table 2-6. Summary of Discrepancy Between Annual Sales and Estimated Annual Revenues for Small Companies: 1999

Discrepancy Size	Number of Firms	Share of Firms	Average Annual Sales ($$10^6$)
< 5 %	1	3 %	$4.5
5 - 10 %	4	11 %	$6.8
10 - 20 %	4	11 %	$6.4
20 - 50 %	9	25 %	$3.7
50 - 100 %	5	14 %	$8.2
> 100 %	13	36 %	$5.8

2.3.5 Market Data and Trends

This section presents historical market data for select BSCP. Historical market data include U.S. volumes for manufacturers' shipments, foreign trade, and apparent consumption. Data were obtained from various years of *Current Industrial Reports* published by the U.S. Bureau of the Census. Table 2-7 provides data for common, building, and face bricks, and structural clay tile, while Table 2-8 presents data for facing tile, glazed and unglazed brick, and vitrified clay and sewer pipe.

As shown in Table 2-7, the brick market shows an overall increasing trend in the quantity of shipments, exports, imports, as well as apparent consumption. This is evident from an examination of the average annual growth rates. The average annual growth rate of brick shipments from 1993 to 1997 was 4.3 percent. For brick imports, the rate is 24.2 percent, much larger relative to the average annual growth rates of shipments, exports, or apparent consumption.

This high average annual growth rate is due to the large increases in imports over the time period presented. Specifically, the imports of bricks increased significantly from about 9 million bricks in 1994 to 16.9 million bricks in 1995. Imports then increased to over 20 million bricks in 1996. Brick exports have remained between 42 and 43 million until the year 1997, when exports peaked at a quantity of 46.5 million.

As shown earlier in Figure 2-2, the market for other structural clay products is much smaller than the brick market, however it still represents an important sector of the BSCP industry. As Table 2-8 shows, the average annual growth rate of select structural clay products is approximately -3.3 percent for the years 1993 to 1997, which is very close to the average annual growth rate for apparent consumption of these same products (-3.4 percent). While shipments and consumption decline over the time period examined, the average annual growth rate of exports is extremely high at 236.9 percent. While this growth rate looks large, it is relatively small in absolute terms. This average growth rate is due, in particular, to a large increase in exports of vitrified sewer pipe from 1993 to 1994. In 1993, 287 short tons were exported from the U.S. and in 1994, exports dramatically rose to 3,187 short tons. This is the main cause of such a large average annual growth rate of exports over the time period represented here. Imports of structural clay products were small, never exceeding 1 thousand short tons in any year between 1993 and 1997.

To determine how significant international trade of bricks and structural clay products is, foreign trade concentration ratios are calculated. Foreign trade concentration ratios demonstrate what share of domestically produced BSCP is exported and what share of apparent consumption is imported. Table 2-9 presents the concentration ratios for brick and structural clay tile and it shows that foreign trade of these products is small relative to the amounts produced and consumed domestically. Of the total quantity produced, only six-tenths of a percent is exported on average. The share of bricks and structural clay tile consumed from abroad is even less at 0.2 percent.

Table 2-7. Historical Data for Brick and Structural Clay Tile (10^3 bricks[a]): 1993 - 1997

Year	Shipment of Bricks	Exports	Imports	Apparent Consumption[b]
1993	6,623,300	42,643	10,170	6,590,827
1994	7,200,000	43,733	8,967	7,165,234
1995	7,243,900	43,627	16,867	7,217,140
1996	7,426,400	42,759	20,629	7,404,270
1997	7,837,600	46,518	20,267	7,811,349
		Average Annual Growth Rates		
1993 - 1997	4.34%	2.28%	24.21%	4.38%

Note: [a]Bricks are 2-1/4 inch by 3-5/8 inch by 7-5/8 inch brick equivalent.

[b]Apparent Consumption = Shipments of Bricks - Exports + Imports

Source: Same data sources as those used for Table 2-6 below.

Table 2-8. Historical Data for Select Structural Clay Products (short tons): 1993 - 1997

Year	Shipments of Select SCP[a]	Exports	Imports	Apparent Consumption[b]
1993	62,552	287	615	62,880
1994	53,959	3,187	915	51,687
1995	51,738	1,543	388	50,583
1996	47,943	1,610	345	46,678
1997	53,750	1,334	888	53,304
		Average Annual Growth Rates		
1993 - 1997	-3.27%	236.88%	34.40%	-3.37%

Note: [a]SCP refers to structural clay products.

[b]Apparent Consumption = Shipments of Select SCP - Exports + Imports

Source: U.S. Department of Commerce, Bureau of the Census. 1998. *Current Industrial Reports for Clay Construction Products - Summary 1997*. <http://www.census.gov:80/cir/www/mq32d.html>
U.S. Department of Commerce, Bureau of the Census. 1996. *Current Industrial Reports for Clay Construction Products - Summary 1995*. <http://www.census.gov:80/cir/www/mq32d.html>
U.S. Department of Commerce, Bureau of the Census. 1995. *Current Industrial Reports for Clay Construction Products - Summary 1994*. <http://www.census.gov:80/cir/www/mq32d.html>

Table 2-10 presents the foreign trade concentration ratios for facing tile, glazed and unglazed brick, and vitrified clay and sewer pipe. The ratios for this market segment are low, but not as low as those calculated for brick and structural clay tile. In this case, 3 percent of domestically produced structural clay products is exported and approximately 1 percent of domestic consumption is supplied from abroad. These calculated ratios shown in Tables 2-9 and 2-10 provide evidence of the minimal foreign trade of BSCP relative to the quantities produced and consumed domestically.

Table 2-9. Foreign Trade Concentration Ratios of Brick and Structural Clay Tile: 1993 - 1997

Year	Exports/Production	Imports/Apparent Consumption
1993	0.64%	0.15%
1994	0.61%	0.13%
1995	0.60%	0.23%
1996	0.58%	0.28%
1997	0.59%	0.26%
Average	0.60%	0.21%

Source: U.S. Department of Commerce, Bureau of the Census. 1998. *Current Industrial Reports for Clay Construction Products - Summary 1997*. <http://www.census.gov:80/cir/www/mq32d.html>
U.S. Department of Commerce, Bureau of the Census. 1996. *Current Industrial Reports for Clay Construction Products - Summary 1995*. <http://www.census.gov:80/cir/www/mq32d.html>
U.S. Department of Commerce, Bureau of the Census. 1995. *Current Industrial Reports for Clay Construction Products - Summary 1994*. <http://www.census.gov:80/cir/www/mq32d.html>

Table 2-10. Foreign Trade Concentration Ratios of Select Structural Clay Products: 1993 - 1997

Year	Exports/Production	Imports/Apparent Consumption
1993	0.46%	0.98%
1994	5.91%	1.77%
1995	2.98%	0.77%
1996	3.36%	0.74%

1997	2.48%	1.67%
Average	3.04%	1.18%

Source: U.S. Department of Commerce, Bureau of the Census. 1998. *Current Industrial Reports for Clay Construction Products - Summary 1997*. <http://www.census.gov:80/cir/www/mq32d.html>
U.S. Department of Commerce, Bureau of the Census. 1996. *Current Industrial Reports for Clay Construction Products - Summary 1995*. <http://www.census.gov:80/cir/www/mq32d.html>
U.S. Department of Commerce, Bureau of the Census. 1995. *Current Industrial Reports for Clay Construction Products - Summary 1994*. <http://www.census.gov:80/cir/www/mq32d.html>

3 ENGINEERING COST ANALYSIS

Production of BSCP results in emissions of HF, HCl, and HAP metals from the kilns used in the production process. To control these emissions, EPA has developed emission standards for these HAPs under the authority of Section 112 of the CAA. This section explains how the nationwide estimate of compliance costs associated with this regulation was developed. Section 3.1 presents the development of model kilns, while Section 3.2 explains how the costs of controlling the kilns to meet the MACT floor are developed. Section 3.3 then describes how the compliance costs associated with model kilns are assigned to the kilns used in the production of BSCP. The nationwide estimate of compliance costs associated with this rule is also provided in this section.

3.1 Development of Model Kilns

Based on information provided from EPA's Section 114 questionnaires (hereafter called EPA's facility database) of the BSCP industry, kilns in the BSCP facilities were determined to be potential major sources of HAP emissions. The varying sizes of kilns used by BSCP facilities necessitates using model kilns to simulate the effects of applying this regulation to the industry. A model kiln does not represent any particular kiln; rather it represents a range of kilns with similar characteristics that may be affected by the regulation. Each kiln is characterized by type (either periodic or tunnel), size (based on production rate), and other parameters that influence the estimates of emissions and control costs. Section 3.1.1 explains how model tunnel kilns were developed and Section 3.1.2 discusses the development of model periodic kilns.

3.1.1 Model Tunnel Kilns

When the model kilns were developed, EPA's facility database had production information for 287 of the 308 tunnel kilns of varying size that are in operation at the 189 BSCP plants. To develop model tunnel kilns, size ranges of small, medium, large, and extra-large were defined based on a comparison of stack gas volumetric flow rates and kiln production rates. Based on this comparison, four model tunnel kilns were defined by their production rates (in tons per hour [tph]) as shown in Table 3-1. To assign each tunnel kiln at BSCP facilities a size as defined in this report, the following criteria were used: kilns with capacities less than 8 tph were considered small kilns; those with capacities ranging from 8 tph to 12.5 tph were considered medium kilns; those with capacities ranging from 12.5 tph to 17.5 tph were considered large; and kilns with capacities greater than or equal to 17.5 tph were considered extra-large kilns.

Table 3-1. Model Tunnel Kiln Definitions

Tunnel Kiln Size Range	Production Rate (tons per hour)
Small	5
Medium	10
Large	15
Extra-large	20

Source: U.S. Environmental Protection Agency. May 10, 2000. "Model Plants - Kilns, Brick and Structural Clay Products Manufacturing Industry Maximum Achievable Control Technology (MACT) Standard Support", Memorandum from Brian Shrager and Mike Abraczinskas, Midwest Research Institute, to Mary Johnson, Environmental Protection Agency, Office of Air Quality Planning and Standards, Emissions Standards Division.

A total of 269 tunnel kilns (for which production and capacity information are available) were operating in 1999 at 155 plants. Table 3-2 specifies the number of tunnel kilns assigned to each model tunnel kiln size. The number of kilns by model size increases as the size of the kiln decreases. Separate model kilns were developed for tunnel kilns that duct some or all of the kiln exhaust to sawdust dryers prior to release to the atmosphere. Table 3-3 shows the number of tunnel kilns/sawdust dryers assigned to each model size.

Table 3-2. Number of Tunnel Kilns by Model Size

Small	Medium	Large	Extra-large	Total
138	82	43	6	269

Source: U.S. Environmental Protection Agency. May 10, 2000. "Model Plants - Kilns, Brick and Structural Clay Products Manufacturing Industry Maximum Achievable Control Technology (MACT) Standard Support", Memorandum from Brian Shrager and Mike Abraczinskas, Midwest Research Institute, to Mary Johnson, Environmental Protection Agency, Office of Air Quality Planning and Standards, Emissions Standards Division.

Table 3-3. Number of Tunnel Kilns/Sawdust Dryers by Model Size

Small	Medium	Large	Extra-large	Total
11	5	2	1	19

Source: U.S. Environmental Protection Agency. May 10, 2000. "Model Plants - Kilns, Brick and Structural Clay Products Manufacturing Industry Maximum Achievable Control Technology (MACT) Standard Support", Memorandum from Brian Shrager and Mike Abraczinskas, Midwest Research Institute, to Mary Johnson, Environmental Protection Agency, Office of Air Quality Planning and Standards, Emissions Standards Division.

3.1.2 Model Periodic Kilns

Across the industry, there are 219 periodic kilns (for which capacity could be estimated) in operation. Unlike tunnel kilns, insufficient data are available to allow EPA to compare flow rates to production rates for model periodic kilns. Nominal production rates, based on the limited available kiln capacity data, of 0.25 tph and 1 tph were chosen for small and large model periodic kilns, respectively. Table 3-4 shows the number of kilns assigned to small and large model periodic kilns.

Table 3-4. Number of Periodic Kilns by Model Size

Small	Large	Total
167	52	219

Source: U.S. Environmental Protection Agency. May 10, 2000. "Model Plants - Kilns, Brick and Structural Clay Products Manufacturing Industry Maximum Achievable Control Technology (MACT) Standard Support", Memorandum from Brian Shrager and Mike Abraczinskas, Midwest Research Institute, to Mary Johnson, Environmental Protection Agency, Office of Air Quality Planning and Standards, Emissions Standards Division.

3.2 Costs of Control

This section provides the estimated costs of installing and operating control technologies that meet the MACT floor. The cost of the add-on control devices varies based on the size and the type of kiln upon which it will be installed. Table 3-5 summarizes the total and annualized capital costs, operating and maintenance expenses, and total annual costs by model kiln. These costs have been scaled to the fourth quarter of the year 2000. For the purpose of this analysis, those major sources that must reduce emissions to comply with the standard are expected to install and operate a control on each existing tunnel kiln with a capacity greater than or equal to 10 tph. Existing tunnel kilns capacities below the 10 tph level and existing periodic kilns will not incur costs related to this regulation. Though all tunnel kilns defined as small required no control equipment to be installed, costs were developed to determine what it would have cost a facility to install and operate a control device.

3.3 National Control Cost Estimates

As discussed in Section 3.2, the Agency developed facility-specific estimates of total annual compliance costs associated with pollution control equipment needed by the point sources to meet the MACT emission limits. This was done by summing the total annual compliance costs over all kilns at each facility. The nationwide annual compliance cost estimate for the affected sources at BSCP facilities is estimated to be $23.96 million, or less than $0.02 per standard brick equivalent (SBE)[3] produced domestically. Note however, that these cost estimates do not account for behavioral responses (i.e., changes in price and output rates).

Table 3-5. Emissions Control Costs of the BSCP Manufacturing NESHAP ($$10^3$)

Facility Number	Company Size	Annualized Capital Cost	Annual O&M Cost	Annual Monitoring Cost	Annualized Compliance Testing Cost	Annual Reporting Cost	Total Annualized Cost
2	small	$0	$0	$0	$0	$0	$0
4	small	$0	$0	$0	$0	$0	$0
3	small	$0	$0	$0	$0	$0	$0
66	large	$0	$0	$0	$0	$0	$0
8	large	$0	$0	$0	$0	$0	$0
148	large	$0	$0	$3,165	$4,026	$16,082	$23,273
110	large	$0	$0	$0	$0	$0	$0
111	large	$0	$0	$0	$0	$0	$0
112	large	$0	$0	$0	$0	$0	$0
130	large	$0	$0	$0	$0	$0	$0

[3] Standard brick equivalent (SBE) is equal to a 4 pound brick and is the standard measure used in the engineering analysis.

(Table 3-5 Continued)

Facility Number	Company Size	Annualized Capital Cost	Annual O&M Cost	Annual Monitoring Cost	Annualized Compliance Testing Cost	Annual Reporting Cost	Total Annualized Cost
149	large	$110,362	$163,553	$3,165	$4,026	$16,082	$297,188
133	large	$215,468	$325,630	$6,330	$8,052	$16,082	$571,562
7	large	$0	$0	$0	$0	$0	$0
5	large	$220,724	$327,106	$6,330	$8,052	$16,082	$578,294
6	large	$180,928	$264,736	$6,330	$8,052	$16,082	$476,128
146	large	$0	$0	$0	$0	$0	$0
12	large	$0	$0	$0	$0	$0	$0
13	large	$0	$0	$6,330	$8,052	$16,082	$30,464
11	large	$90,464	$132,368	$3,165	$4,026	$16,082	$246,105
74	large	$90,464	$132,368	$3,165	$4,026	$16,082	$246,105
10	large	$180,928	$264,736	$6,330	$8,052	$16,082	$476,128
138	large	$0	$0	$0	$0	$0	$0
82	large	$110,362	$163,553	$3,165	$4,026	$16,082	$297,188
131	large	$180,928	$264,736	$6,330	$8,052	$16,082	$476,128
132	large	$110,362	$163,553	$3,165	$4,026	$16,082	$297,188
81	large	$271,392	$397,104	$9,495	$12,078	$16,082	$706,151
72	large	$125,004	$193,262	$3,165	$4,026	$16,082	$341,539
73	large	$220,724	$327,106	$6,330	$8,052	$16,082	$578,294
51	large	$90,464	$132,368	$3,165	$4,026	$16,082	$246,105
16	small	$0	$0	$0	$0	$0	$0
17	small	$110,362	$163,553	$3,165	$4,026	$16,082	$297,188
105	small	$0	$0	$0	$0	$0	$0
152	small	$0	$0	$0	$0	$0	$0
18	small	$0	$0	$0	$0	$0	$0
181	large	$0	$0	$0	$0	$0	$0
19	small	$180,928	$264,736	$6,330	$8,052	$16,082	$476,128
14	small	$0	$0	$0	$0	$0	$0
15	small	$0	$0	$0	$0	$0	$0
20	small	$90,464	$132,368	$3,165	$4,026	$16,082	$246,105
33	small	$0	$0	$0	$0	$0	$0
34	small	$0	$0	$3,165	$4,026	$16,082	$23,273
134	small	$271,392	$397,104	$9,495	$12,078	$16,082	$706,151
64	small	$0	$0	$0	$0	$0	$0
83	small	$0	$0	$0	$0	$0	$0
84	small	$90,464	$132,368	$3,165	$4,026	$16,082	$246,105

(Table 3-5 Continued)

Facility Number	Company Size	Annualized Capital Cost	Annual O&M Cost	Annual Monitoring Cost	Annualized Compliance Testing Cost	Annual Reporting Cost	Total Annualized Cost
21	small	$0	$0	$0	$0	$0	$0
188	large	$0	$0	$0	$0	$0	$0
189	large	$0	$0	$0	$0	$0	$0
153	small	$0	$0	$0	$0	$0	$0
23	small	$0	$0	$0	$0	$0	$0
65	small	$0	$0	$0	$0	$0	$0
24	small	$0	$0	$0	$0	$0	$0
161NR	small	$0	$0	$0	$0	$0	$0
162NR	small	$0	$0	$0	$0	$0	$0
163NR	small	$0	$0	$0	$0	$0	$0
158	small	$0	$0	$0	$0	$0	$0
29	large	$0	$0	$0	$0	$0	$0
28	large	$0	$0	$0	$0	$0	$0
31	large	$180,928	$264,736	$12,660	$16,104	$16,082	$490,510
150	large	$0	$0	$6,330	$8,052	$16,082	$30,464
77	large	$0	$0	$3,165	$4,026	$16,082	$23,273
67	large	$0	$0	$0	$0	$0	$0
70	large	$0	$0	$6,330	$8,052	$16,082	$30,464
25	large	$0	$0	$3,165	$4,026	$16,082	$23,273
32	large	$0	$0	$0	$0	$0	$0
26	large	$110,362	$163,553	$3,165	$4,026	$16,082	$297,188
27	large	$180,928	$264,736	$6,330	$8,052	$16,082	$476,128
30	large	$0	$0	$0	$0	$0	$0
78	small	$220,724	$327,106	$6,330	$8,052	$16,082	$578,294
63	small	$0	$0	$0	$0	$0	$0
38	small	$0	$0	$0	$0	$0	$0
174NR	small	$0	$0	$0	$0	$0	$0
169NR	large	$220,724	$327,106	$6,330	$8,052	$16,082	$578,294
167NR	large	$0	$0	$0	$0	$0	$0
165NR	large	$0	$0	$0	$0	$0	$0
166NR	large	$180,928	$264,736	$6,330	$8,052	$16,082	$476,128
168NR	large	$125,004	$193,262	$3,165	$4,026	$16,082	$341,539
173NR	large	$220,724	$327,106	$6,330	$8,052	$16,082	$578,294
41	large	$220,724	$327,106	$6,330	$8,052	$16,082	$578,294
164NR	large	$90,464	$132,368	$3,165	$4,026	$16,082	$246,105

(Table 3-5 Continued)

Facility Number	Company Size	Annualized Capital Cost	Annual O&M Cost	Annual Monitoring Cost	Annualized Compliance Testing Cost	Annual Reporting Cost	Total Annualized Cost
170NR	large	$220,724	$327,106	$6,330	$8,052	$16,082	$578,294
171NR	large	$200,826	$295,921	$6,330	$8,052	$16,082	$527,211
172NR	large	$215,468	$325,630	$6,330	$8,052	$16,082	$571,562
178NR	small	$0	$0	$0	$0	$0	$0
71	small	$0	$0	$0	$0	$0	$0
177NR	small	$0	$0	$0	$0	$0	$0
9	small	$0	$0	$0	$0	$0	$0
35	small	$0	$0	$0	$0	$0	$0
36	small	$90,464	$132,368	$6,330	$8,052	$16,082	$253,296
145	large	$0	$0	$0	$0	$0	$0
125	large	$0	$0	$0	$0	$0	$0
97	large	$271,392	$397,104	$9,495	$12,078	$16,082	$706,151
98	large	$200,826	$295,921	$6,330	$8,052	$16,082	$527,211
127	large	$0	$0	$0	$0	$0	$0
126	large	$0	$0	$0	$0	$0	$0
94	large	$0	$0	$0	$0	$0	$0
92	large	$0	$0	$0	$0	$0	$0
118	large	$0	$0	$0	$0	$0	$0
129	large	$110,362	$163,553	$3,165	$4,026	$16,082	$297,188
143	large	$180,928	$264,736	$6,330	$8,052	$16,082	$476,128
99	large	$0	$0	$0	$0	$0	$0
151	large	$0	$0	$3,165	$4,026	$16,082	$23,273
95	large	$110,362	$163,553	$3,165	$4,026	$16,082	$297,188
128	large	$0	$0	$3,165	$4,026	$16,082	$23,273
96	large	$90,464	$132,368	$3,165	$4,026	$16,082	$246,105
93	large	$0	$0	$0	$0	$0	$0
175NR	small	$0	$0	$0	$0	$0	$0
104	small	$0	$0	$0	$0	$0	$0
37	small	$0	$0	$0	$0	$0	$0
139	small	$0	$0	$0	$0	$0	$0
135	small	$110,362	$163,553	$3,165	$4,026	$16,082	$297,188
142	small	$0	$0	$0	$0	$0	$0
183	small	$0	$0	$0	$0	$0	$0
40	small	$0	$0	$0	$0	$0	$0
50	small	$0	$0	$0	$0	$0	$0

(Table 3-5 Continued)

Facility Number	Company Size	Annualized Capital Cost	Annual O&M Cost	Annual Monitoring Cost	Annualized Compliance Testing Cost	Annual Reporting Cost	Total Annualized Cost
42	small	$90,464	$132,368	$3,165	$4,026	$16,082	$246,105
107	small	$0	$0	$0	$0	$0	$0
109	small	$0	$0	$0	$0	$0	$0
106	small	$0	$0	$0	$0	$0	$0
108	small	$0	$0	$0	$0	$0	$0
184	small	$0	$0	$0	$0	$0	$0
113	small	$0	$0	$0	$0	$0	$0
79	small	$0	$0	$0	$0	$0	$0
114	small	$0	$0	$0	$0	$0	$0
87	small	$0	$0	$0	$0	$0	$0
88	small	$0	$0	$0	$0	$0	$0
43	small	$0	$0	$0	$0	$0	$0
156	small	$0	$0	$0	$0	$0	$0
122	small	$0	$0	$0	$0	$0	$0
136	small	$0	$0	$0	$0	$0	$0
68	small	$0	$0	$0	$0	$0	$0
69	small	$0	$0	$0	$0	$0	$0
44	small	$0	$0	$0	$0	$0	$0
176NR	small	$0	$0	$0	$0	$0	$0
123	large	$0	$0	$0	$0	$0	$0
86	large	$0	$0	$0	$0	$0	$0
154	large	$0	$0	$6,330	$8,052	$16,082	$30,464
137	small	$361,856	$529,472	$12,660	$16,104	$16,082	$936,174
159	small	$0	$0	$0	$0	$0	$0
45	small	$0	$0	$0	$0	$0	$0
89	small	$0	$0	$0	$0	$0	$0
157	small	$180,928	$264,736	$6,330	$8,052	$16,082	$476,128
48	large	$90,464	$132,368	$3,165	$4,026	$16,082	$246,105
49	large	$345,728	$520,368	$9,495	$12,078	$16,082	$903,751
179	small	$0	$0	$0	$0	$0	$0
76	small	$0	$0	$0	$0	$0	$0
185	small	$0	$0	$0	$0	$0	$0
90	small	$0	$0	$3,165	$4,026	$16,082	$23,273
140	small	$0	$0	$0	$0	$0	$0
160NR	small	$0	$0	$0	$0	$0	$0

(Table 3-5 Continued)

Facility Number	Company Size	Annualized Capital Cost	Annual O&M Cost	Annual Monitoring Cost	Annualized Compliance Testing Cost	Annual Reporting Cost	Total Annualized Cost
115	small	$0	$0	$0	$0	$0	$0
141	small	$0	$0	$0	$0	$0	$0
46	small	$0	$0	$0	$0	$0	$0
91	small	$0	$0	$0	$0	$0	$0
80	small	$0	$0	$0	$0	$0	$0
39	small	$0	$0	$0	$0	$0	$0
116	small	$0	$0	$0	$0	$0	$0
186	large	$0	$0	$0	$0	$0	$0
187	large	$0	$0	$0	$0	$0	$0
117	small	$0	$0	$0	$0	$0	$0
47	small	$0	$0	$0	$0	$0	$0
144	large	$0	$0	$0	$0	$0	$0
121	large	$0	$0	$0	$0	$0	$0
120	large	$0	$0	$0	$0	$0	$0
155	small	$0	$0	$3,165	$4,026	$16,082	$23,273
119	small	$90,464	$132,368	$3,165	$4,026	$16,082	$246,105
180NR	small	$0	$0	$0	$0	$0	$0
124	small	$0	$0	$0	$0	$0	$0
75	small	$0	$0	$0	$0	$0	$0
60	large	$110,362	$163,553	$3,165	$4,026	$16,082	$297,188
52	large	$180,928	$264,736	$6,330	$8,052	$16,082	$476,128
53	large	$125,004	$193,262	$3,165	$4,026	$16,082	$341,539
100	large	$0	$0	$0	$0	$0	$0
61	large	$90,464	$132,368	$3,165	$4,026	$16,082	$246,105
56	large	$0	$0	$0	$0	$0	$0
22	large	$0	$0	$0	$0	$0	$0
1	large	$0	$0	$3,165	$4,026	$16,082	$23,273
85	large	$0	$0	$0	$0	$0	$0
57	large	$0	$0	$0	$0	$0	$0
58	large	$110,362	$163,553	$3,165	$4,026	$16,082	$297,188
59	large	$110,362	$163,553	$3,165	$4,026	$16,082	$297,188
101	large	$110,362	$163,553	$3,165	$4,026	$16,082	$297,188
54	large	$220,724	$327,106	$6,330	$8,052	$16,082	$578,294
102	large	$0	$0	$0	$0	$0	$0
103	large	$0	$0	$0	$0	$0	$0

(Table 3-5 Continued)

Facility Number	Company Size	Annualized Capital Cost	Annual O&M Cost	Annual Monitoring Cost	Annualized Compliance Testing Cost	Annual Reporting Cost	Total Annualized Cost
62	large	$0	$0	$0	$0	$0	$0
55	large	$200,826	$295,921	$6,330	$8,052	$16,082	$527,211
182NR	small	$0	$0	$0	$0	$0	$0
147	small	$0	$0	$0	$0	$0	$0

Source: U.S. Environmental Protection Agency. November 21, 2002. “BCSP and Clay Ceramics NESHAP: Final Rule Economic Inputs for Brick and Structural Clay Products Manufacturing.” Memorandum from Brian Shrager, Midwest Research Institute, to Mary Johnson, Environmental Protection Agency, Office of Air Quality Planning and Standards, Emissions Standards Division.

4 ECONOMIC IMPACT ANALYSIS

The proposed rule to control the release of HAPs from brick and structural clay product facilities will directly (through imposition of compliance costs) or indirectly (through changes in market prices) affect the entire U.S. industry. Implementation of the proposed rule will increase the costs of producing BSCP at affected plants. These costs will vary across facilities depending on their physical characteristics and baseline controls. The response by producers to these additional costs will determine the economic impacts of the regulation. Specifically, the cost of the regulation may induce some owners to change their current operating rates or to close their operations. These choices affect, and in turn are affected by, the market prices for bricks and structural clay products.

This section describes the data and approach used to estimate the economic impacts of this proposed regulation. Section 4.1 presents the inputs for the economic analysis, including producer characterization, market characterization, and compliance costs of the regulation. Section 4.2 describes the methodological approach to estimating the economic impacts on the industry, and Section 4.3 presents the results of the economic impact analysis. Section 4.4 provides an economic analysis of new sources that are projected to be built for the production of BSCP.

4.1 Economic Analysis Inputs

Inputs to the economic analysis are a baseline characterization of the producers of BSCP that includes their production levels and capacity, their markets, and the estimated costs of complying with the proposed regulation. There are two distinct markets in which the BSCP facilities may operate in depending on the products they produce. The economic analysis therefore examines both. The market for bricks is analyzed separately from the market for other structural clay products.

4.1.1 Producer Characterization

The baseline characterization of BSCP producers is based principally on the information in EPA's facility database. The information contained in the EPA facility database was based on industry's response to an Information Collection Request (ICR) and in general, describes the facilities and their production activities for the year 1996. This database, along with average plant capacity utilization rates and volume of shipments data gathered from various Bureau of the Census publications, were used to develop a 1999 baseline characterization of the brick and structural clay products markets. Using the 1996 baseline characterization would not be adequate since new kilns that are estimated to incur compliance costs have been installed at some facilities since 1996. Because the emissions from these kilns may have to be controlled to comply with this regulation, they are included in the analysis.

The nature of the BSCP industry changed during the latter half of the 1990s. Market demand steadily increased throughout 1997 and 1998, thereby leading to increasing plant capacity utilization as well as the installation of new kilns to boost production. Since EPA's facility database includes information on the BSCP industry for the year 1996, projections about facility production and capacity were made in order to reflect the industry as it existed in 1999. While the average capacity utilization rate for SIC 3251 in 1996 was 87 percent, it increased to over 90 percent in 1997 and continued to grow[4]. To account for the increased output of bricks and structural clay products in 1999, the production levels of those facilities with significantly low capacity utilization rates in 1996 were increased based on the 1998 average capacity utilization rate for the industry (94 percent), the latest year for which this measure is available.

In addition, some facilities included in the database were missing data. These facilities were either:

- missing production or capacity data; or
- missing both production and capacity data.

For those facilities that were missing either production or capacity data, the 1998 average capacity utilization rate for SIC 3251 was used to estimate the missing information. For those facilities for which no production or capacity data were available (all of which were brick manufacturing facilities), the residual difference between the 1999 brick production total reported in the *Current Industrial Reports for Clay Construction Products* (U.S. Census Bureau, 2000) and the production total of the brick facilities in the database was allocated across facilities based on whether they are considered small or large[5]. The allocation of the residual brick production was based on a ratio of the average production quantities for the small and large brick manufacturing facilities in the database. Additionally, the production capacity data for these facilities were based on the average capacity utilization rates of the small and large facilities in the database.

These facility-specific data on existing major sources were supplemented with secondary information on bricks and structural clay products from the Brick Industry Association (BIA), market prices for bricks and for structural clay products derived from various publications released by the U.S. Bureau of the Census, and BSCP cost equations developed for this analysis (as described fully in Appendix B).

4.1.2 Brick and Structural Clay Product Markets

Table 4-1 provides baseline data on the U.S. brick and structural clay products markets used in this analysis. The market price for bricks was derived by dividing the 1999 value of brick shipments by the quantity of bricks produced in that year (U.S. Census Bureau, 2000). The market price for structural clay products was calculated in a similar manner. Market production volumes for bricks and for structural clay products are the sum of U.S. production and foreign imports. The *Current Industrial Reports for Clay Construction*

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[4] The average capacity utilization rate for SIC 3251 (Brick and Structural Clay Tile) in the *Current Industrial Reports - 1998 Survey of Plant Capacity* (U.S. Census Bureau, 2000) was used in this analysis since a majority of the BSCP facilities are owned by companies in this SIC code category.

[5] Facility size is based on whether it is owned by a small or large company, as defined by the Small Business Administration size standards.

Products (U.S. Bureau of the Census, 2000) reports U.S. production of bricks and structural clay products for 1999. Foreign trade data on exports and imports of these products were also taken from the same publication.

Table 4-1. Baseline Characterization of U.S. Brick and Structural Clay Products Markets: 1999

	Brick	Structural Clay Products
Market price ($/SBE[a])	$0.19	$0.80
Market production (1,000 SBE)	8,573,450	316,586
Domestic production (1,000 SBE)	8,552,821	310,706
Foreign Trade (1,000 SBE)		
Exports	42,759	1,945
Imports	20,629	5,880

Note: [a]SBE means standard brick equivalent, based on a 4 pound brick. Prices are based on 1999 value of shipments divided by 1999 market production.

Source: U.S. Department of Commerce, Bureau of the Census. 1999. *Current Industrial Reports for Clay Construction Products - Summary 1999*.

4.1.3 Regulatory Control Costs

The Agency developed compliance cost estimates for each of the 189 BSCP manufacturing facilities potentially affected by the regulation. These estimates reflect the “most-reasonable” scenario for this industry in that they estimate the costs of installing and operating pollution control equipment. Though the baseline characterization of the brick and structural clay products manufacturing facilities represents the industry in year 1999, the regulatory control costs are current as of the 4th quarter of year 2000. For this source category, compliance costs for the facilities arise from the installation of dry injection fabric filters on tunnel kilns with design capacities equal to or greater than 10 tph, as well as the operation, maintenance, and testing of this pollution control equipment. Other costs may stem from monitoring, recordkeeping, and reporting of emissions as well as testing costs. These cost estimates serve as inputs to the economic analysis and affect the operating decisions for each potentially affected facility. A total of 68 facilities are expected to incur positive compliance costs to comply with the NESHAP that totaled $23.96 million.

Revenues for each facility were estimated based on the market prices for bricks and structural clay products shown in Table 4-1 and their reported production levels from the 1999 baseline producer characterization.

4.2 Economic Impact Methodology

This section summarizes the Agency's economic approach to modeling the responses by producers of BSCP and markets to the imposition of this proposed regulation. In conducting an economic analysis, the alternatives available to each producer in response to the regulation and the context of these choices are important in determining the economic impacts. Based on the regulatory control cost estimates, the Agency has evaluated the economic impacts of this NESHAP using a market-based approach that gives producers the choice of whether to continue producing BSCP and, if so, to determine the optimal level consistent with market signals.

The Agency's approach is soundly based on standard microeconomic theory, employs a comparative statics approach, and assumes certainty in relevant markets. Prices and quantities are determined in perfectly competitive markets for both bricks and structural clay products. Production decisions involve whether a firm with a plant and equipment already in place purchases inputs to produce output. These are sometimes called short-run decisions since the plant and equipment are fixed. A profit-maximizing firm will operate existing capital as long as the market price for its output exceeds its per-unit variable production costs. As long as the market price even marginally exceeds the average variable (operating) costs, the firm will cover not only the cost of its variable inputs but also part of its capital costs. Thus, in the short run, a profit-maximizing firm will not pass up an opportunity to recover even part of its fixed investment in the plant and equipment. However, in the long run, the firm must cover all of its fixed investment in the plant and equipment. Under this more stringent condition, the market price must exceed its average total costs, which include capital and variable input costs. For this analysis, the Agency employs the short-run criteria to estimate the economic impacts of the proposed NESHAP.

The Agency developed cost curves for each type of product at affected facilities. Given the capital in place, each product at an affected facility is characterized by an upward-sloping supply function, as shown in Figure 4-2. The supply function lies along the same locus of points as the marginal cost curve, which is bounded by zero and by the technical capacity at the facility. The facility owner is willing to supply output according to this schedule as long as market price is sufficiently high to cover average variable costs. If the market price falls below the average variable costs, then the firm's best response is to cease production because total revenue does not cover total

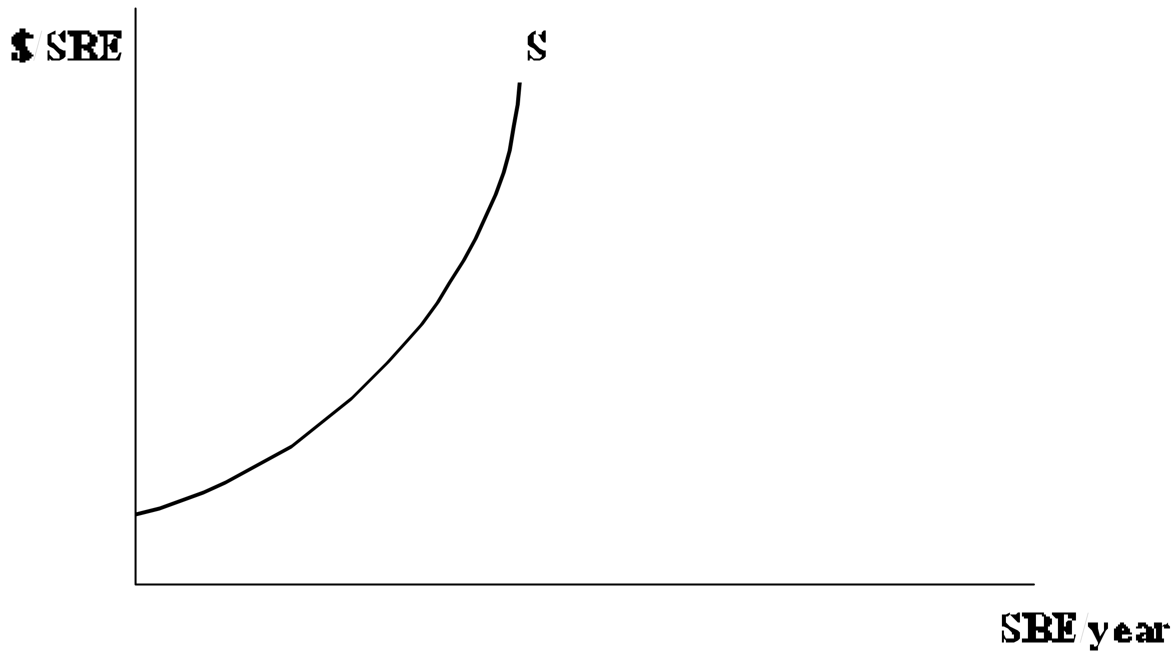

Figure 4-2. Supply Curve for Affected Facilities

variable costs of production. In other words, when price is less than average variable costs, the supply curve lies along the vertical axis because zero quantity is supplied at those prices.

The individual facility-level supply decisions can be aggregated to develop the market supply curve. This economic analysis assumes that prices for bricks and structural clay products are determined in perfectly competitive markets (i.e., individual facilities have negligible power over the market price of the products and thus take the prices as "given" by the market). As shown in Figure 4-3(a), under perfect competition, market prices and quantities are determined by the intersection of market supply and demand curves. The initial baseline scenario consists of a market price and quantity (P, Q) that is determined by the downward-sloping market demand curve (D^M) and the upward-sloping market supply curve (S^M) that reflects the sum of the individual supply curves of affected and unaffected facilities. Now consider the effect of the regulation on the baseline scenario. Incorporating the regulatory control costs will involve shifting upward the supply curve for each affected facility by the per-unit compliance cost (operating and maintenance plus annualized capital). As a result of the upward shift in the supply curve for each affected facility, the market supply curve for each product will shift upward to reflect the increased costs of production at affected facilities.

The estimated per-unit total annual compliance cost of the MACT standards is incorporated into the baseline market scenario as shown in Figure 4-3(b). In the baseline scenario without the MACT standards, at the projected price, P, the industry would produce total output, Q, with affected facilities producing the amount q_d and unaffected facilities accounting for Q minus q_d, or q_i. The regulation raises the average total production cost (annualized capital costs plus annual operating and maintenance costs) of affected facilities causing their supply curves to shift upward from S_d to S_d' and the market supply curve to shift upward to $S^{M'}$. At the new equilibrium with the regulation, the market price increases from P to P' and market output (as determined from the market demand curve, D^M) declines from Q to Q'. This reduction in market output is the net result from reductions at affected facilities and increases at unaffected facilities.

To estimate the economic impacts of the regulation under this scenario, the conceptual model described above was operationalized in a Lotus 1-2-3 multiple spreadsheet model for both the brick and structural clay product markets. Appendix B provides the details of the operational market model for this economic analysis. In summary, this model characterizes domestic and foreign producers and consumers of each product and their behavioral responses to the imposition of the regulatory compliance costs. These costs are expressed per standard brick equivalent (SBE) for each facility and serve as the input to the market model, or the “cost shifters” of the baseline supply curves at the facility. Given these costs for directly affected facilities, the model determines a new equilibrium solution with higher market prices and reductions in output of each product.

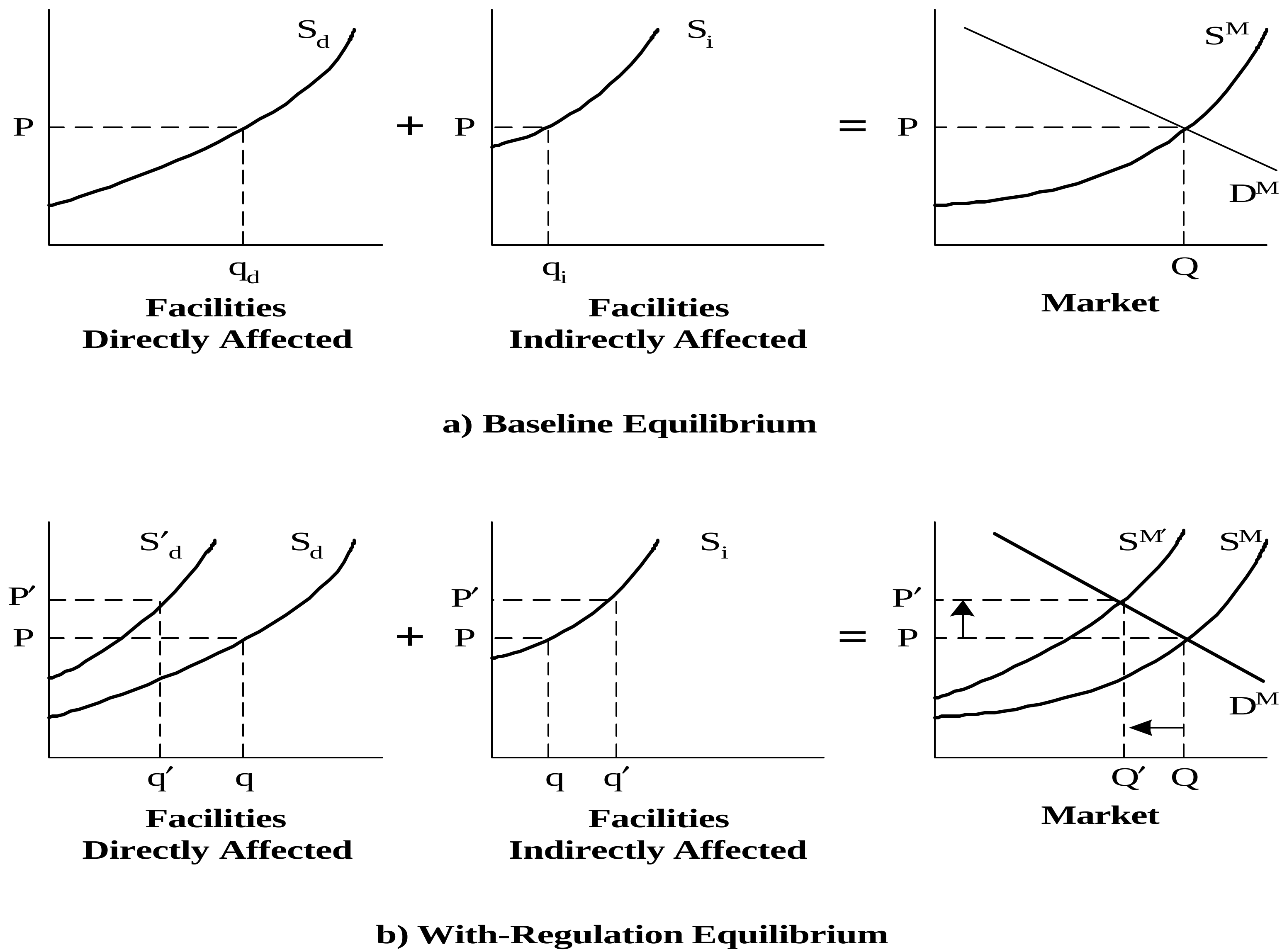

Figure 4-3. Market Equilibrium Without and With Regulation

4.3 Economic Impact Results

This section provides the economic impacts of the regulation under the approach described in Section 4.2. The model results are summarized below as market-, industry-, and society-level impacts due to the regulation.

4.3.1 Market-Level Results

Table 4-2 provides the market-level impacts of the regulation, which include the market adjustments in price and quantity for bricks and structural clay products and the changes in foreign trade. The increased cost of controlling HAPs causes affected producers to increase the price of bricks. As price increases, consumers may buy fewer bricks and instead purchase substitute house siding materials such as wood or vinyl siding. The industry has indicated that stron competition exist between brick and vinyl siding products. These price and output changes affects equilibrium in the brick market. No structural clay product producers face costs of controlling HAPs, however, so price and output of structural clay products are unaffected by the regulation. The proposed regulation will increase the price of bricks and reduce market output. The market price for bricks is expected to increase by 0.9 percent, while market quantity will decline by 1.4 percent, or 117 million SBE per year. The reduction in market quantities of bricks are the net effect of reductions in domestic production and increases in foreign imports.

The NESHAP impacts foreign trade of bricks by reducing exports and increasing imports. As shown in Table 4-2, exports of bricks from the U.S. are expected to decline by 1.4 percent (or 584 thousand SBE per year). Alternatively, imports of bricks to the U.S. are expected to increase by 1.4 percent (or 286 thousand SBE per year). Once again, because there is no change in price in the structural clay products market, exports and imports in this market are unaffected.

Table 4-2. Summary of Market-Level Impacts of the Proposed NESHAP: 1999

	Baseline	With Regulation	Changes from Baseline Absolute	Changes from Baseline Percent
Brick				
Market price ($/SBE)	$0.19	$0.19	$0.002	0.9%
Market output (1,000 SBE/yr)	8,573,450	8,456,366	-117,084	-1.4%
Domestic production (1,000 SBE/year)	8,552,821	8,435,451	-117,370	-1.4%
Exports	42,759	42,175	-584	-1.4%
Imports	20,629	20,915	286	1.4%
Structural Clay Products				
Market price ($/SBE)	$0.80	$0.80	$0.000	0.0%
Market output (1,000 SBE/yr)	316,586	316,586	0	0.0%
Domestic production	310,706	310,706	0	0.0%
Exports	1,945	1,945	0	0.0%
Imports	5,880	5,880	0	0.0%

Source: U.S. Department of Commerce, Bureau of the Census. 1998. *Current Industrial Reports for Clay Construction Products - Summary 2000*.

4.3.2 Industry-Level Results

Table 4-3 summarizes the national-level industry impacts associated with this regulation. Industry-level impacts include an evaluation of the changes in revenue, costs, profits, potential facility closures, and the change in employment attributable to projected closures and reductions in production of BSCP from affected facilities.

The industry revenues and costs change as brick prices and production levels adjust to the imposition of the regulation. While the initial engineering cost estimate of the rule is $23.9 million, after accounting for market adjustments, the industry is expected to incur $22.5 million annually in regulatory compliance costs. The primary reason for the difference in the engineering cost estimate of the rule and the resulting regulatory cost after accounting for market adjustments is the estimation that 2 facilities would close and not incur regulatory cost. As shown in Table 4-3, based on projected individual and market responses, the economic analysis estimates industry profits to decrease by $8.7 million. The reduction in profits results from a reduction in revenues and an increase in costs due to the regulation. This reduction in profits is less than the regulatory costs brick producers incur because they reduce their production, resulting in higher market prices per SBE, which effectively shifts a portion of the regulatory burden onto consumers. In addition to the reduction in revenues, increase in costs, and reduction in profits, the economic analysis predicts a decline in employment by 167 full-time equivalents due to the proposed regulation.

Table 4-3. National-Level Industry Impacts Summary of the Proposed NESHAP: 1999

			Changes from Baseline	
	Baseline	With Regulation	Absolute	Percent
Revenues ($\$10^3$/yr)	$1,873,601	$1,8663,061	-$7,540	-0.4%
Costs ($\$10^3$ /yr)	$1,787,415	$1,788,545	$1,129	0.1%
Regulatory control costs	$0	$22,512	$22,512	NA
Production costs	$1,787,415	$1,766,032	- $21,383	-1.2%
Profits ($\$10^3$/yr)	$86,185	$77,516	-$8,669	-10.1%
Employment (FTEs)	12,230[a]	12,063	-167	-1.0%
Operating facilities (#)	189	187	-2	-1.1%

Note: NA means not applicable.
A. The change in profit is based on a ratio of baseline profits to baseline vale of shipments. This ratio is applied to the change in value of shipments to derive the estimated change in profits.
B. FTE refers to full-time equivalents. The change in employment is based on a ratio of baseline employment to baseline production. This ratio is applied to the change in production to derive the change in employment.
[C]Represents total number of employees in 167 facilities that provided data.

Table 4-3 also shows that the economic model projects closures of BSCP facilities associated with imposition of the rule. Two facilities are projected to close, neither of which is owned by a small business. It is important to point out that the estimates of facility closures are sensitive to the accuracy of the baseline characterization of the BSCP facilities and the estimation of incremental compliance costs for these plants. Uncertainty regarding the accuracy of the closure estimates is introduced through the use of a generalized cost function to project baseline operating costs at specific facilities and the assumptions required to project production and capacity and compliance costs at each facility. These uncertainties are likely to influence the specific type of plant projected to close more so than the aggregate estimate of closures.

Table 4-4 presents distributional industry impacts of the rule that are not apparent from the aggregate national level industry impacts shown in Table 4-3. Impacts are examined across those firms that are projected to experience a loss in profits, and a gain in profits due to the imposition of the regulation. Of the 189 facilities in the BSCP source category, 55 facilities (29 percent) are expected to lose profits, while 134 (71 percent) are expected to gain profits due to the increase in market price for bricks. Thus, the industry-level loss in profits of $8.7 million is the net measure of profit losses at the 55 facilities (totaling $15.0 million) and the profit gains at the 134 facilities (totaling $6.4 million).

As shown, the BSCP facilities with profit losses are slightly larger in terms of capacity utilization, generate larger volumes of BSCP, and incur much higher incremental compliance costs (in aggregate, per 1,000 SBE) than those facilities with profit increases. In addition, Table 4-4 shows that the negatively affected facilities, as a group, slightly reduced their capacity utilization from 84.6 percent in baseline to 80.2 percent, while positively affected facilities, as a group, slightly increased their capacity utilization from 74.4 percent in baseline to 75.1 percent with the rule. Employment is also impacted by the regulation. It is estimated that employment will decline by 167 employees due to the rule.

4.3.3 Social Costs of the Regulation

The value of a regulatory action is traditionally measured by the change in economic welfare that it generates (see Appendix C for a discussion on economic welfare). Welfare impacts resulting from this regulation on U.S. society will extend to the many consumers and producers of bricks. Because the regulation imposes no costs on structural clay product facilities, there are no welfare effects on consumers and producers of structural clay products. Brick consumers will experience welfare impacts due to the adjustments in market prices and consumption levels of brick that result from imposition of the regulation. Producer welfare impacts result from the changes in revenues to brick producers associated with the imposition of the rule and the corresponding changes in production and market prices.

Table 4-4. Summary of Distributional Industry Impacts of the Proposed BSCP NESHAP: 1999

	With Profit Loss[a]	With Profit Gain	Total, U.S.
Number	55	134	189
Capacity (1,000 SBE)			
Total	5,575,870	5,563,776	11,139,646
Per Facility	101,379	41,521	58,940
Incremental Compliance Costs			
Total ($1,000/yr)	$22,179	$334	$22,512
Per 1,000 SBE	$5.08	$0.04	$2.58
Capacity Utilization			
Baseline	84.6%	74.4%	77.3%
With Regulation	80.2%	75.1%	78.5%
Change in Profits ($$10^3$/yr)	-$15,037	$6,367	-$8,669

Note: [a]The incremental compliance costs for the facilities with projected profit loss includes the estimated costs of facilities that are projected to close.

Based on applied welfare economics principles, Table 4-5 presents the estimates of the social costs and their distribution by stakeholder. The social cost of the proposed NESHAP is estimated to be $23.3 million annually and is distributed across consumers and producers of bricks based on the projected market adjustments. Consumers of BSCP are expected to incur $14.7 million annually due to the increase in prices and reductions in consumption. This burden is borne mostly by domestic consumers ($14.6 million) as compared to foreign consumers ($0.1 million). Domestic and foreign structural clay product consumers are not affected by this rule.

Producers are expected to absorb $8.6 million annually due to increased costs and reduction in revenues resulting from changes in market prices and output. Domestic brick producers lose about $8.7 million annually, which equals their decrease in profits, while the foreign producers of brick gain by almost $0.1 million due to the increase in U.S. price for bricks. Once again, neither the domestic or foreign structural clay product producers are impacted by the regulation. Hence, they experience no changes in welfare.

Table 4-5. Distribution of Social Costs Associated with the Proposed NESHAP: 1999

Stakeholder	Change in Value ($ 10^3)
Consumer surplus, total	-$14,695
Domestic	
Brick	-$14,621
Structural Clay Products	$0
Foreign	
Brick	-$74
Structural Clay Products	$0
Producer surplus, total	-$8,633
Domestic	
Brick	-$8,669
Structural Clay Products	$0
Foreign	
Brick	$36
Structural Clay Products	$0
Social Costs of Regulation	$23,328

4.4 New Source Analysis

The Agency projects 13 new 15 tph and 2 new 7.5 tph kilms to begin operation during the five year period following promulgation of this NESHAP. New suppliers of BSCP have an investment decision: whether to commit to a new facility of a given scale. They have no fixed factors and thus may select any technically feasible facility configuration. Of course, they may also elect not to make an investment in this industry. Economic theory suggests investors are expected to invest in a project when the discounted value of the expected stream of profits over the lifetime of the investment exceeds the costs of the investment, or alternatively when the internal rate of return (IRR) is greater than the opportunity cost of capital. Commodity prices and production costs are central to this decision.

The competitive model of price formation is provided in Figure 4-4. In the figure, the willingness of existing suppliers to produce alternative rates of bricks and structural clay products is represented by S_E and the demand for BSCP is shown as D_0. The equilibrium market price, P_0, is determined by the intersection of these curves. If this price exceeds the annualized capital costs discounted at the opportunity cost of capital for an investment in this risk class divided by the profit-maximizing output rate plus the unit cost of other inputs, the producer commits to a new facility; otherwise no investment occurs. Figure 4-4 shows a constant cost industry where market price is exactly equal to the unit cost of new facilities, S_N.

In a growing industry, the demand for the commodity is shifting outward (e.g., to D_1), placing upward pressure on prices and providing the incentive for investors to add new productive capacity.[6] As new capacity enters the market, the new equilibrium price is P_1, which is exactly equal to the unit cost of supply from new facilities. In this example, it is the same value as the old price, P_0. The new equilibrium quantity, Q_1, includes the additional output supplied by new sources: $(Q_1–Q_0)$.

The NESHAP will increase existing suppliers' costs of producing BSCP if they use tunnel kilns that exceed the 10 tph threshold. This is represented by a shifting of existing supply, S_E, up. It will also increase the costs of supply from new facilities using tunnel or periodic kilns regardless of their production rate. All new kilns are to be controlled according to this NESHAP. These increases in costs will place upward pressure on prices. As shown in Figure 4-5, with demand curve, D_1, prices would be expected to increase with shifts in supply until the price of bricks and structural clay products, P_1N, is equal to the unit cost of supply from new facilities including the cost of the NESHAP. However, as shown in Figure 4-6, no new capacity expansion will take place in the future time period if the per-unit compliance costs at new facilities exceeded P_1N. Thus, the simple analytics presented suggest that the rule will likely cause investors to delay construction of new facilities *until the price increase is just enough* to cover all the costs of production.

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[6] For simplicity, impacts are considered for one future time period.

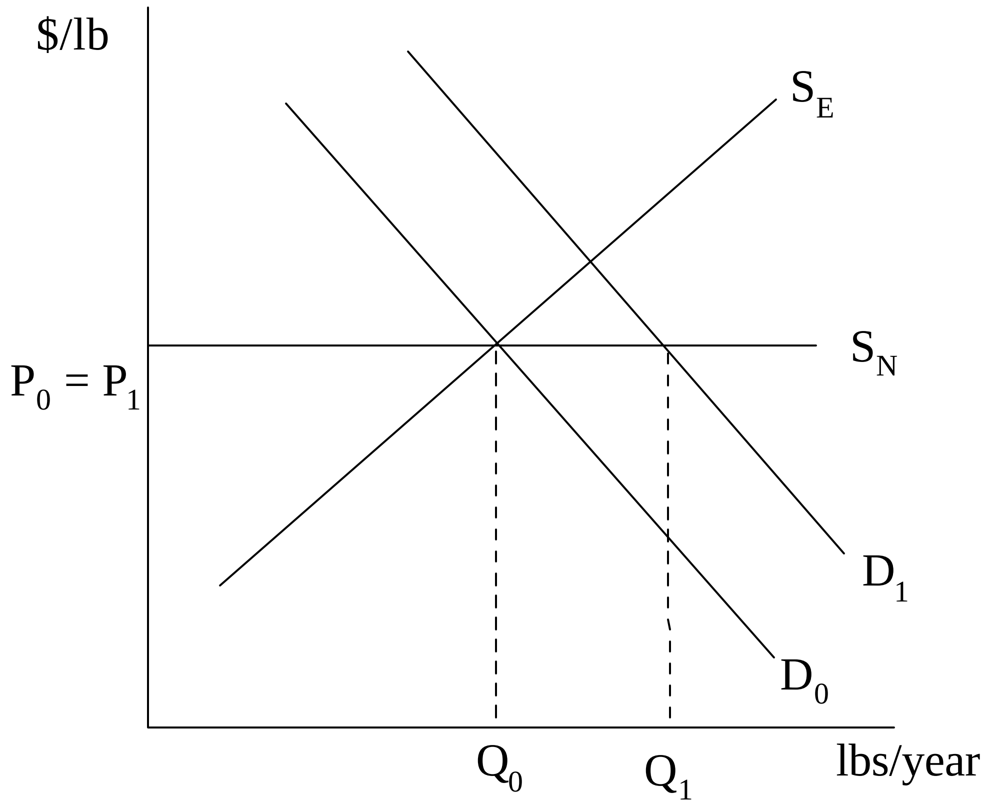

Figure 4-4. Baseline Equilibrium without Regulation

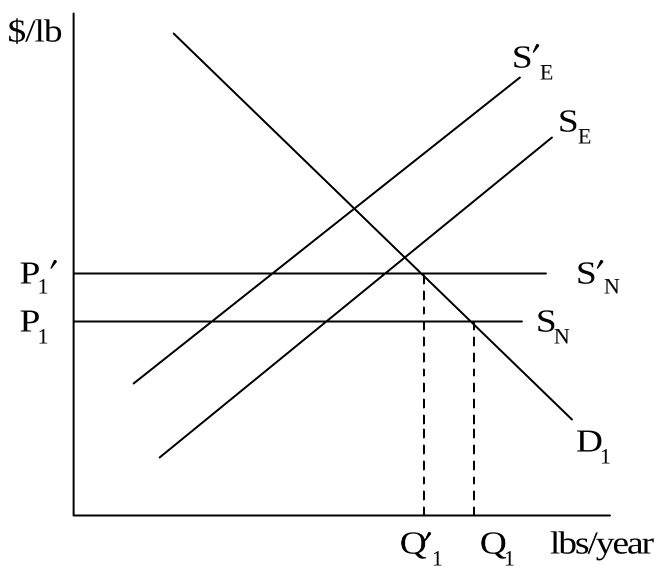

Figure 4-5. With-Regulation Equilibrium Case 1: New Sources Added

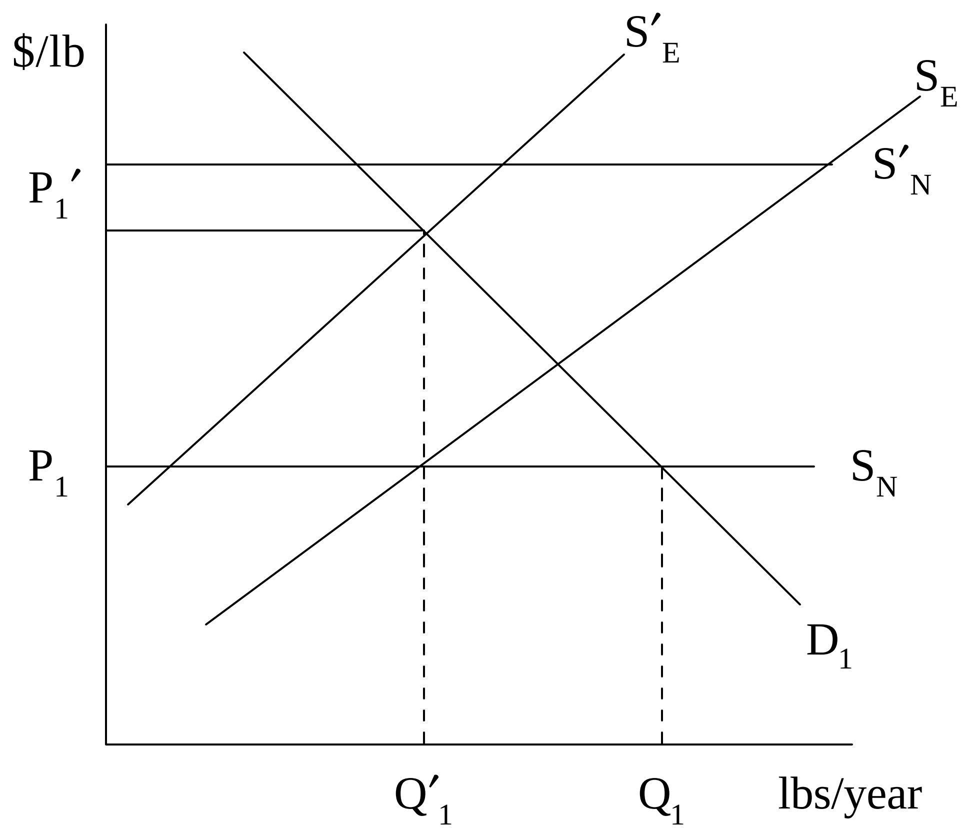

Figure 4-6. With-Regulation Equilibrium Case 2: No New Sources Added

Given the uncertainty about new brick facility unit costs (production and compliance) and future market conditions, the Agency is limited to general assessments of the rule's impact on the rate of new facility construction. To inform these assessments, the Agency performed the following analysis:

- *Computation of a test ratio for the affected brick product market*. Due to the expected increase in the demand for brick, the numerator of this ratio is the engineering estimate of the unit costs of compliance for new brick sources (approximately \$0.01 per SBE for a new kiln subject to the MACT floor standard). The denominator for this ratio is the unit cost of a new brick supplier, which is assumed to be equal to the estimated baseline market price. As shown in Table 4-6, the production-weighted cost share for the market is 4.2 % under the MACT floor standard.

Table 4-6. New Source Analysis of Unit Production and Compliance Costs for BSCP Markets

New Source Unit Costs (\$/SBE)[a]	New Source Unit Compliance Costs (\$/SBE)	Cost Share (%)
\$.19	\$0.008	4.2%

Note: [a]Equal to the baseline market price by assumption.

- *Projection of percentage change in kiln construction with regulation for a future time period (2007).* Using the conceptual approach presented in Figures 4-4 and 4-5, the Agency estimated the change in kiln construction for the five-year period following promulgation of this regulation as:

$$\Delta Facilities \quad \frac{\Delta Q_{2007}}{Z} \quad \eta_d \cdot Q_{2007} \cdot \frac{\Delta P}{P} \qquad (4.1)$$

where

η_d = Elasticity of demand (assumed to be –1.0)

Z = Average size of a new kiln (56.5 million SBE/yr)

Q_{2007} = The Census (U.S. Census Bureau, 2000) provided a brick production estimate of 8.55 billion SBE for 1999, the latest year this information is available. For the five year period following promulgation, the engineering analysis independently projected brick growth of 904 million SBE. Thus, the quantity for the 2007 is projected to be approximately 9.45 billion SBE.

$\frac{\Delta P}{P}$ = Calculated using the ratio of production-weighted average new source per-unit control costs to baseline price (4.2 percent for the MACT floor)

Using this approach, the Agency estimated a 40 percent reduction in output by new sources under the MACT floor over the five-year time period following promulgation (see Table 4-7).

The results of the impact of the BSCP manufacturing NESHAP on new sources has three alternative interpretations:

- If it is assumed all new kilns produce at 100 percent capacity, then it is projected that the construction of 6 kilns of the 15 projected to come on line would be delayed due to the regulation,
- All 15 new kilns are constructed as expected, but each kiln operates at a capacity utilization rate that is reduced by 40 percent, or
- All 15 new kilns are constructed, but since they use the latest technology, they produce at lower cost; hence, 6 older (marginal) kilns shut down due to the regulation.

Table 4-7. New Source Sensitivity Analysis for the Brick and Structural Clay Products NESHAP

Elasticity of Demand	Projected Reduction in Quantity (10^3 SBE)	Projected % Reduction of Total Quantity	Number of Delayed Kilns
-1	358,888	39.7%	5.9
-0.75	269,392	29.8%	4.5
-0.5	178,992	19.8%	2.9

The above results are sensitive to the assumption of elasticity of demand. Also shown in Table 4-7 are the results of a sensitivity analysis where the elasticity of demand of BSCP varies from unitary elastic to inelastic. As these results show, the more elastic is demand, the larger is the impact of the regulation. For example, if demand elasticity is assumed to be -0.5, then it is expected that output produced by the new kilns would on be reduced by about 20 percent. This means that if new sources were operating at maximum capacity, construction of only 3 kilns is projected to be delayed.

If we compare the total annual compliance costs of approximately $5.9 million faced by the 9 of the projected kilns to use DIFF ($470,000 per tunnel kiln), 4 are projected to use DLA ($297,000 per tunnel kiln) and the 2 new small kilns are projected to use DLA

(195) to the BSCP manufacturing value of shipments for 1997, the latest year available (U.S. Census Bureau, 1999), we find that these costs represent less than 0.4 percent of the value of shipments.

4.5 Energy Impacts

Executive Order 13211 "Actions Concerning Regulations that Significantly Affect Energy Supply, Distribution, or Use" (66 Fed. Reg. 28355, May 22, 2001) requires federal agencies to estimate the energy impact of significant regulatory actions. The proposed NESHAP will trigger both an increase in energy use due to the operation of new abatement equipment as well as a decrease in energy use due to a decline in BSCP production. The net impact will be an overall increase in the industry's energy costs by about $3.22 million per year. These impacts are discussed below in greater detail.

4.5.1 Increase in Energy Consumption

As described earlier in Section 3 of this report, brick and structural clay products manufacturing facilities that do not meet the MACT floor are projected to install dry injection fabric filters to reduce their HAP emissions in compliance with the proposed regulation. The associated increase in total energy demand stemming from the compliance with this NESHAP is estimated to equal 91 billion Btu/year or approximately 26.7 million kilowatthours/year. The U.S. Department of Energy reports that the average retail prices of electricity for the industrial sector was $0.044 per kilowatthour in the base year of 1999 (DOE, 1999a). Therefore, the nationwide cost of the energy needed to operate the control equipment is estimated at $1.17 million per year.

4.5.2 Reduction in Energy Consumption

The economic model described earlier in this section predicts that increased compliance costs will result in an annual production decline of approximately 117,084 SBEs valued at about $22.2 million collectively. This production decline will lead to a corresponding decline in energy usage by brick and structural clay product manufacturers. EPA has computed an average 'energy per unit output ratio' and multiplied it by the decline in production to quantify this impact.

Census data presented in Table 4-8 indicates that the U.S. brick and structural clay products manufacturing industry incurred energy costs of $175.6 million to produce $1.45 billion worth of bricks and structural clay products in 1997. This translates into an energy consumption per unit of output ratio of 0.12 percent for the BSCP manufacturing industry. Therefore, energy costs are estimated to decline by $0.03 million per year if the industry's production declines by 117,084 SBE valued at $22.2 million per year.

Table 4-8. Energy Usage in Brick and Structural Clay Products Manufacturing

Industry Sector	NAICS Code	Value of Shipments ($$10^6$)	Fuel & Electricity Costs ($$10^6$)

Brick and Structural Clay Products Manufacturing	327121	$1,452.2	$175.6

Source: U.S. Department of Commerce, Bureau of the Census. 1999. 1997 Census of Manufacturing Industry Series: Brick and Structural Clay Tile Manufacturing.

4.5.3 Net Impact on Energy Consumption

The operation of additional abatement capital is estimated to result in an increase in energy use worth $1.17 million per year while the decrease in BSCP manufacturing will result in a decrease in energy use worth $0.03 million per year. These competing factors will result in a net increase in annual energy consumption by the BSCP industry of approximately $1.14 million, on balance.

The total electricity generation capacity in the U.S. was 785,990 Megawatts in 1999 (DOE, 1999b). Thus, the electricity requirements associated with the proposed abatement capital represent a small fraction of domestic generation capacity. Hence, the proposed NESHAP is not likely to have any significant adverse impact on energy prices, distribution, availability or use.

5 SMALL BUSINESS ANALYSIS

This regulatory action will potentially affect the economic welfare of owners of brick and other structural clay product facilities. The ownership of these facilities ultimately falls on private individuals who may be owner/operators that directly conduct the business of the firm or, more commonly, investors or stockholders that employ others to conduct the business of the firm on their behalf (i.e., privately-held or publicly-traded corporations). The individuals or agents that manage these facilities have the capacity to conduct business transactions and make business decisions that affect the facility. The legal and financial responsibility for compliance with a regulatory action ultimately rests with these agents; however, the owners must bear the financial consequences of the decisions. Environmental regulations like this rule potentially affect all businesses, large and small, but small businesses may have special problems in complying with such regulations.

The Regulatory Flexibility Act (RFA) of 1980 requires that special consideration be given to small entities affected by federal regulation. The RFA was amended in 1996 by the Small Business Regulatory Enforcement Fairness Act (SBREFA) to strengthen the RFA's analytical and procedural requirements. Under SBREFA, the Agency must perform a regulatory flexibility analysis for rules that will have a *significant* impact on a *substantial* number of small entities.

This section identifies the businesses that will be affected by this proposed rule and provides an analysis to assist in determining whether this rule is likely to impose a significant impact on a substantial number of the small businesses within this industry. The screening analysis employed here is a "sales test" that computes the annualized compliance costs as a share of sales for each company. In addition, it provides information about the impacts on small businesses after accounting for producer responses to the rule and the resulting changes in market price and output, as detailed in Section 4.

5.1 Identifying and Characterizing Small Businesses

The companies operating in the Brick and Structural Clay Products industry can be grouped into small and large categories using Small Business Administration (SBA) general size standard definitions for NAICS codes. The SBA defines a small business in terms of the employment or annual sales of the owning entity. These thresholds vary by industry and are evaluated based on the industry classification (NAICS codes) of the impacted facilities. Five different NAICS codes are represented across the brick and other structural clay product facilities with a small business definition range from 500 to 750 employees. In determining the companies' NAICS size standard, the following assumptions were made:

- A NAICS code for one company could not be found. In this case, the most conservative size standard of 750 employees was applied.
- Seven companies own facilities that did not report SIC codes, NAICS codes, or reported incorrect codes. For these companies, the NAICS codes listed in publicly accessible databases, such as Dun & Bradstreet, were assigned.
- In cases where companies own facilities with multiple NAICS codes, the most conservative SBA definition was used. For example, if a company owned facilities with NAICS 327121 (size standard = 500 employees) and NAICS 327993 (size standard = 750 employees), the size standard of 750 employees was applied.

Based on the SBA definitions, the Agency identified 76 of the companies owning facilities that produce BSCP as small (84 percent) and 14 as large (15 percent) (See Appendix A for a detailed listing).

5.2 Screening-Level Analysis

For the purposes of assessing the potential impact of this rule on these small businesses, the Agency considered the MACT floor of **dry injection fabric filters** and calculated the share of annual compliance cost relative to baseline sales for each company. When a company owns more than one facility, the costs for each facility it owns are summed to develop the numerator of the test ratio. For this screening-level analysis, annual compliance costs were defined as the engineering control costs imposed on these companies; thus, they do not reflect the changes in production expected to occur in response to imposition of these costs and the resulting market adjustments.

As mentioned in Section 2.3 of the industry profile, the annual sales figures used to calculate cost-to-sales ratios for the small business screening analysis are from publicly available company profiles or are estimated in the EIA based on production values reported in company survey responses. For 39 of the 77 small businesses, the EIA estimated revenues exceeded publicly reported annual sales data. In these cases, the EIA estimated revenues were used in the calculation of cost-to-sales ratio. Sales may be under-reported in publicly available profiles because they represent the annual sales of a subsidiary or branch of a company or because the providing organization generated their sales estimates. Additionally, relying on estimated revenues instead of potentially under-reported company sales data makes consistent the results across the facility-level economic impacts model (in Section 4) and the small business cost-to-sales ratio screening analysis (in Section 5). For more details about the EIA estimated revenues, please consult Section 2.3.4.

Table 5-1 reports total compliance costs, the number of companies impacted at the zero, one, and three percent levels, and provides summary statistics for the cost-to-sales ratios (CSRs) for small companies. As shown in Table 5-1, the aggregate compliance costs of small businesses totals $5 million, which is 17 percent of the total industry costs of $23.96 million under the MACT floor option. Under the rule, the annual compliance costs incurred by small businesses range from zero to approximately 4 percent of their sales with 80 percent of small businesses not incurring any regulatory costs. The 61 companies with zero cost-to-sales ratio own brick and structural clay products manufacturing facilities that do not have a design capacity exceeding 10 tph or that have chosen to take a permit that effectively limits their sources' design capacity to the 10 tph cutoff. While there a large number of small business incur no additional compliance costs, there are still some small firms with positive cost-to-sales ratios. Of the small companies with a positive cost-to-sales ratio, a majority have CSRs between 1 and 3 percent.

Table 5-1 also makes a comparison across the small companies that incur compliance costs associated with this regulation to the entire group of small companies operating in the industry. The table presents an average (median) cost-to-sales ratio of 2.2 (2.3) percent for the directly affected small companies with a distribution ranging from a minimum of 0.2 percent to a maximum of 4.5 percent. If all small firms operating in the industry are considered together (i.e., those not affected by the rule and those directly affected), the average (median) cost-to-sales ratio is 0.4 (0.0) percent.

5.3 Economic Analysis

The Agency also analyzed the economic impacts on small businesses under with-regulation conditions expected to result from implementing the proposed NESHAP. Unlike the screening-level analysis described above, this approach examines small business impacts in light of the expected behavioral responses of producers and consumers to the regulation. As shown in Table 5-2, pre-tax earnings for facilities owned by small businesses are projected to decrease by a little over $500 thousand under the MACT floor. Production costs are expected to increase due to regulatory costs, which are offset by a reduction in the change in the quantity of bricks produced. Of the 93 facilities operated by small businesses, none are expected to close due to the regulation. In addition, employment at small firms is expected to decline by 23 full-time equivalent positions.

5.4 Assessment

At proposal, approximately 10 percent of small businesses had a cost-to-sales ratio (CSR) that exceeded 3 percent. Based on changes made for the final rule and a reduction in regulatory costs of approximately $10 million, we estimate 3 small firms (3.9 percent) will have a CSR that exceeds 3 percent. In addition, we estimate that 9 firms (11.8 percent) will have a CSR between 1 and 3 percent. In order to gain better insight on how significantly these small businesses will be impacted by the MACT floor, we compare the estimated CSRs with a profitability measure for these firms. While data on the profit rates of the firms in this analysis were not available, the U.S. Census Bureau reports quarterly return-to-sales for corporations in the Standard Industrial Classification (SIC) major group 32 (Stone, Clay, Glass, and Concrete Products) with assets less than $25 million (U.S. Bureau of the Census, 1998). This SIC major group includes more than just the firms in this analysis, but it still provides the best available measure of their profit margin. We weighted the quarterly rates by sales to derive the 1997 return-to-sales of 4.6 percent for this industry segment. There are no small businesses with cost-to-sales ratios that exceed the Census-based estimate of profit margin for the SIC major group 32. This means that though the compliance costs associated with this regulation may lead some small firms to incur costs that are greater than 3 percent of sales, they are not high enough to warrant firm closures in most cases. In addition, a definitive conclusion cannot be drawn using the SIC major group 32 profit margin because its calculation included more than brick and structural clay product manufacturing companies. For comparison purposes, we also calculated this profitability measure for all corporations in SIC 32 (4.5 percent) and those corporations in SIC 32 with assets over $25 million (4.1 percent). The Census data indicate that profit rates are consistent across larger and smaller corporations within this SIC major group.

Eighty percent of small businesses in the brick and structural clay products industry will face zero compliance costs associated with this regulation. While there are some small businesses that do have positive cost-to-sales ratios, there are few in number. In addition, no facilities owned by a small business are projected to close and none of the firms have cost-to-sales ratio that exceed the average profit margin for the SIC group the brick and structural clay products industry is in. For this reason, this NESHAP is not expected to have a significant impact on a substantial number of small businesses.

Table 5-1. Summary Statistics for Small Business Analysis for BSCP Facilities[a]

	Small	Share of Total
Total Number of Companies[b]	76	84.4%
Annual MACT Floor Costs ($$10^3$/yr)	$4,993	20.8%
Cost-to-Sales Ratios - Distribution	Number	Share
Impacted at 0%[c]	61	80.2%
Impacted <1%	3	3.9%
Impacted at $1 to 3%	9	11.8%
Impacted at $3%	3	3.9%
Cost-to-Sales Ratios - Summary Statistics	Directly Affected	All Small Firms
Average	2.2%	0.4%
Median	2.3%	0.0%
Maximum	4.5%	4.5%
Minimum	0.2%	0.0%

[a] Screening impacts shown in this table do not account for firm and market response to regulation, i.e., no change in sales.
[b] Sales data for the companies are taken either from Dun & Bradstreet data or are estimated based on production figures reported in company survey responses.
[c] Companies with facilities considered synthetic minors or taking permit limits have zero costs, and therefore have cost-to-sales ratios equal to 0%.

Table 5-2 Summary of Small Business Impacts Proposed BSCP Manufacturing NESHAP: 1999

	Baseline	With Regulation	Changes from Baseline	
			Absolute	Percent
Revenues ($\$10^3$ /yr)	$637,637	$642,777	$5,140	0.8%
Costs ($\$10^3$ /yr)	$608,306	$613,949	$5,643	0.9%
Regulatory control costs	$0	$4,993	$4,993	NA
Production costs	$608,306	$608,828	$651	0.1%
Profits ($\$10^3$/yr)	$29,331	$28,828	-$503	-1.7%
Employment (FTEs)	5,116	5,093	-23	-0.5%
Operating facilities (#)	93	93	0	0.0%

Note: NA means not applicable.
FTE refers to full-time equivalents.
[a]Represents total number of employees in 82 facilities owned by small businesses that provided data.

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APPENDIX A: SUMMARY BRICK AND STRUCTURAL

CLAY PRODUCTS (BSCP) COMPANY DATA

Table A-1. Summary Data for Companies Operating BSCP Facilities

Company Name	Number of Facilities	Employment	Sales ($10^6)	Small Business
American Eagle Brick Co., Inc.	1	NR	NR	Y
Atkinson Brick Co., Inc.	2	NR	NR	Y
Belden Brick Co.	8	NR	NR	N
Boral Industries, Inc.[1]	18	NR	NR	N
Brick and Tile Corp. of Lawrenceville	2	NR	NR	Y
Can-Clay Corp.	1	NR	NR	Y
Carolina Ceramics, LLC	1	NR	NR	Y
Castaic Clay Manufacturing Co., Inc.	1	NR	NR	Y
Certainteed Corp.	1	NR	NR	N
Cherokee Brick and Tile, Co., Inc.	1	NR	NR	Y
Clay City Pipe[2]	2	NR	NR	Y
Clinton-Campbell Contractor, Inc.	1	NR	NR	Y
Colonial Brick Co., Inc.	1	NR	NR	Y
Columbus Brick Co., Inc.	1	NR	NR	Y
Commercial Brick Corp.	1	NR	NR	Y
Continential Brick Co., Inc.	1	NR	NR	Y
Cunningham Brick Co., Inc.	2	NR	NR	Y
D'Hanis Clay Products, Inc.	1	NR	NR	Y
Dti Investors, L.L.C.	2	NR	NR	N
Elgin-Butler Brick Co.	1	NR	NR	Y
Endicott Clay Products Co., Inc.	1	NR	NR	Y
Eureka Brick and Tile Co., Inc.	1	NR	NR	Y
Florida Brick and Clay Co., Inc.	1	NR	NR	Y
General Clay Products Corp.	3	NR	NR	Y
General Finance, Inc.	1	NR	NR	Y
Hanson, PLC	12	NR	NR	N

Henry Brick Co., Inc.	1	NR	NR	Y
Higgins Brick Co., Inc.	1	NR	NR	Y
Hoffman Enterprises, Inc.	1	NR	NR	Y
Hope Brick Works, Inc.	1	NR	NR	Y
Ibstock PLC	10	NR	NR	N
International Chimney Corp.[3]	1	NR	NR	Y
Interpace Industries, Inc.	1	NR	NR	Y
Iskilar Brick, Inc.[4,5]	1	NR	NR	Y
J.L. Anderson Co., Inc.	1	NR	NR	Y

Company Name	Number of Facilities	Employees	Sales	Small Business
Jenkins Brick Co., Inc.	2	NR	NR	Y
Jordan Industries[6]	1	NR	NR	N
Justin Industries[7]	16	NR	NR	N
Kansas Brick and Tile Co., Inc.	1	NR	NR	Y
Kasten Clay Products, Inc.	1	NR	NR	Y
Kentwood Brick and Tile Manufacturing Co., Inc.	1	NR	NR	Y
L.P. McNear Brick Co., Inc.	1	NR	NR	Y
Lee Brick and Tile Co., Inc.	1	NR	NR	Y
Logan Clay Products Co., Inc.	1	NR	NR	Y
London Tile Co.	1	NR	NR	Y
Louisville Brick Co., Inc.	1	NR	NR	Y
Marion Ceramics, Inc.	1	NR	NR	Y
Marseilles Brick Venture Limited Partnership	1	NR	NR	N
McAvoy Vitrified Brick Co.	1	NR	NR	Y
MCP Industries, Inc.	4	NR	NR	Y
Metropolitan Ceramics, Inc.	1	NR	NR	Y
Morin Brick Co., Inc.	2	NR	NR	Y
Mutual Materials Co., Inc.	3	NR	NR	Y
Nash Brick Co., Inc.	1	NR	NR	Y
New London Brick, Inc.	1	NR	NR	Y
Ochs Brick and Tile Co.	1	NR	NR	Y
Old Carolina Brick Co.	1	NR	NR	Y
Old Virginia Brick Co., Inc.	2	NR	NR	Y

Company Name	Number of Facilities	Employees	Sales	Small Business
Owensboro Brick and Tile Co.	1	NR	NR	Y
Pacific Clay Products, Inc.	1	NR	NR	Y
Pacific Coast Building Products	3	NR	NR	N
Pine Hall Brick Co., Inc.	1	NR	NR	Y
Ragland Clay Products	1	NR	NR	Y
Richards Brick Co., Inc.	1	NR	NR	Y
Richland Moulded Brick Co.	1	NR	NR	Y
Robinson Brick Co., Inc.	1	NR	NR	Y
Roeben Tonbaustoffe[8]	2	NR	NR	N
Saint Joe Brick Works, Inc.	1	NR	NR	Y
Scott Jewett Truck Line, Inc.[9]	1	NR	NR	Y
Seneca Tiles, Inc.	1	NR	NR	Y
Sioux City Brick and Tile Co.[10]	2	NR	NR	Y
Snyder Brick and Tile Co., Inc.	1	NR	NR	Y
Southern Brick and Tile Co., Inc.	1	NR	NR	Y
Stark Ceramics, Inc.	1	NR	NR	Y
Statesville Brick Co.	1	NR	NR	Y
Stiles and Hart Brick Co.	1	NR	NR	Y
Stone Creek Brick Co., Inc.	1	NR	NR	Y
Summit Pressed Brick and Tile Co., Inc.[11]	2	NR	NR	Y
Summitville Tiles, Inc.	2	NR	NR	N
Superior Clay Corp.	1	NR	NR	Y
Taylor Clay Products, Inc.	1	NR	NR	Y
Texas Industries, Inc.[12]	3	NR	NR	N
The Denver Brick Co., Inc.	1	NR	NR	Y
Tri-State Brick and Tile Co., Inc.	1	NR	NR	Y
Vermont Brick Manufacturing, LP	1	NR	NR	Y
Watsontown Brick Co., Inc.	1	NR	NR	Y
Wheeler Brick Co., Inc.	1	NR	NR	Y
Wienerberger Baustoffindustrie AG[13]	18	NR	NR	N
Yadkin Brick Co.	1	NR	NR	Y
Yankee Hill Brick Manufacturing Co., Inc.	1	NR	NR	Y
Totals	189	$10,964	89,904	77 small, 13 large

NR means Not Reported. Employment and sales data were used in the economic impact analysis, but those data taken from Dun & Bradstreet which are considered proprietary and are therefore not included in this table.

[1] **Boral Industries, Inc. owns U.S. Tile.**

[2] **Clay City Pipe owns Bowerston Shale Co.**

[3] **International Chimney Corp. owns Continental Clay Co.**

[4] **Iskilar Brick, Inc. owns Darlington Brick and Clay Products Co.**

[5] **Iskilar Brick, Inc. owns Powell and Minnock Brick Works, Inc.**

[6] **Jordan Industries owns Daaco, Inc..**

[7] **Justin Industries owns Texas Clay Products.**

[8] **Roeben Co., Inc. owns Triangle Brick Co.**

[9] **Scott Jewett Truck Line, Inc. owns Mangum Brick Co.**

[10] **Sioux City Brick and Tile Co. owns United Brick and Tile Co.**

[11] **Summit Pressed Brick and Tile Co., Inc. owns Lakewood Brick and Tile Co.**

[12] **Texas Industries owns Athens Brick Co.**

[13] **Wienerberger Baustoffindustrie AG owns General Shale.**

APPENDIX B

ECONOMIC MODEL OF THE BRICK AND STRUCTURAL CLAY PRODUCTS MARKETS

Implementation of the proposed MACT standards will affect the costs of production in the brick and structural clay products industry for existing plants. Responses at the facility level to these additional costs will collectively determine the market impacts of the regulation. Specifically, the cost of the regulation may induce some facilities to alter their current level of production or to close. These choices affect, and in turn are affected by, the market price for each product. The Agency has employed standard microeconomic concepts to model the supply of each product and the impacts of the regulation on production costs and the output decisions of BSCP facilities. The main elements of the analysis are to

- characterize production of each product at the individual facility and market levels,
- characterize demand for each product, and
- develop the solution algorithm to determine the new post-regulatory equilibrium.

B.1 Supply of Brick and Structural Clay Products

Market supply of BSCP (Q^s) may be expressed as the sum of domestic and foreign supply, or imports:

$$Q^s = q^s + q^I \qquad \text{(B.1)}$$

where q^s is the domestic supply of a particular clay product, which is the sum of production from affected (q^a) and unaffected (q^u) facilities, and q^I is the foreign supply, or imports. Each of these supply components is described below.

B.1.1 Affected Facilities

The Agency has developed individual supply functions for each clay product at affected facilities. Producers of bricks and structural clay products have the ability to vary output in the face of production cost changes. Upward-sloping supply curves for each product are developed to allow these facilities to respond in this manner when regulatory costs are imposed. For this analysis, the generalized Leontief profit function was used to derive the supply curve for each clay product at each facility. This functional form is appropriate given the fixed-proportion material input (clay minerals) and the variable-proportion inputs of chemicals, labor, electricity, and energy. Applying Hotelling's lemma to the generalized Leontief profit function produces the following general form of the supply functions at affected facilities for each structural clay product:

$$q_j^* \quad \gamma_j \quad \frac{\beta}{2}\left[\frac{1}{p}\right]^{\frac{1}{2}} \tag{B.2}$$

where p is the market price for the each product, $(_j$ and $\$$ are model parameters, and j indexes producers (i.e., individual affected facilities). The theoretical restrictions on the model parameters that ensure upward-sloping supply curves are $(_j > 0$ and $\$ < 0$.

Figure B-1 illustrates the theoretical supply function of Eq. (B.2). The upward-sloping supply curve is specified over a productive range with a lower bound of zero that

corresponds with a shutdown price equal to $\frac{\beta^2}{4\gamma_j^2}$ and an upper bound given by the

productive capacity of q^M_j that is approximated by the supply parameter $(_j$. The curvature of the supply function is determined by the $\$$ parameter.

To specify the supply function of Eq. (B.2) for this analysis, the $ parameter is computed by substituting an assumed market supply elasticity for each product (>), the market price of the product (p), and the production-weighted, average annual production level of affected facilities $(\bar{q}^{*})$ into the following equation:

$$\beta \quad \xi 4 \bar{q}^{*} \left[\frac{1}{p}\right]^{-\frac{1}{2}} \tag{B.3}$$

Absent econometric or literature estimates, the market-level supply elasticity will be assumed to be 1, which makes supply unit elastic (i.e., a 1 percent change in price leads to a 1 percent change in output). The foreign supply elasticity is assumed to be 1.5. The 1999 market prices of each product are given as described above, and the average annual production level

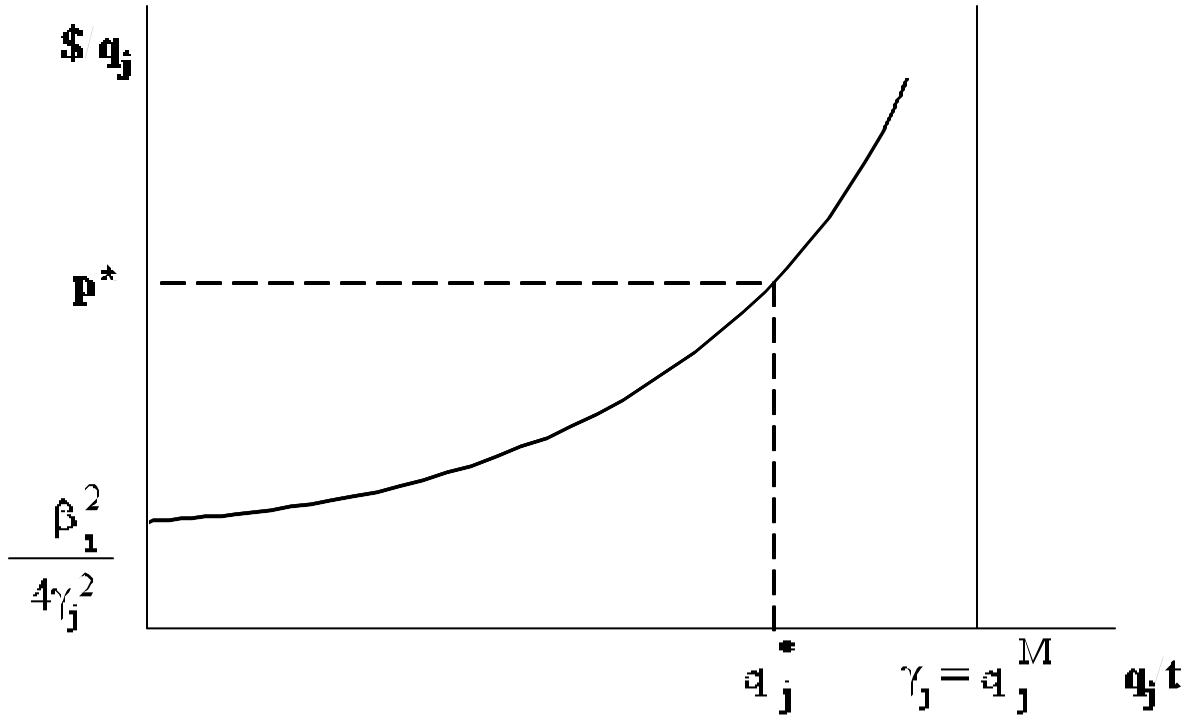


Figure B-1. Theoretical Supply Function for Affected Facilities

of each clay product per facility are derived from facility-level information in the EPA facility database. The $ parameter for each structural clay product is then calculated by incorporating these values into Eq. (B.3). Because of the variation in size across brick facilities, a distinct $ parameter is estimated for the small, medium, and large facility categories.

Supply Function Intercept

The intercept of the supply function, $(_j$, approximates the productive capacity and varies across products at each facility. This parameter does not influence the facility's production responsiveness to price changes as does the $ parameter. Thus, the parameter $(_j$ is used to calibrate the model so that each affected facility's supply equation is exact using the baseline production data for 1999.

Regulatory Response

The production decisions at these facilities are affected by the total annual compliance costs, c_j, which are expressed per standard brick equivalent (SBE). Total annual compliance cost estimates were provided by EPA's engineering analysis and include annual capital costs, annual operating and maintenance costs, and applicable monitoring costs. Each supply equation will be directly affected by the regulatory control costs, which enter as a net price change (i.e., $p_j - c_j$). Thus, the supply function for each affected facility from Eq. (B.2) above becomes:

$$q_j^{*} \quad \gamma_j \quad \frac{\beta}{2}\left[\frac{I_j}{p_j - c_j}\right]^{\frac{1}{2}} \tag{B.4}$$

The total annual compliance costs per SBE are projected given the annual production per facility and EPA's regulatory cost estimates for each facility.

A.1.2 Unaffected Facilities

These facilities are not directly affected by the regulation and will be modeled as a single representative supplier. Supply of each structural clay product from these facilities (q^u) may be expressed by the following general formula for each product, that is,

$$q^{u} \quad A^{u} p_j^{\xi^{u}} \tag{B.5}$$

where p is the market price for the product, $>^u$ is the domestic supply elasticity (assumed to be 0.5), and A^u is a multiplicative supply parameter that calibrates the supply equation for each product given data on price and the supply elasticity to replicate the observed 1999 level of production from these facilities.

B.1.3 Foreign Supply (Imports)

Similar to unaffected facilities, foreign producers are not directly affected by the regulation but will be included in the model as a single representative supplier. Supply of clay products from foreign producers (q^I) may be expressed by the following general formula for each product:

$$q^I = A^I p^{\xi^I} \tag{B.6}$$

where p is the market price for the product, $>^I$ is the import supply elasticity (assumed to be 1.5), and A^I is a multiplicative supply parameter that calibrates the supply equation for each product given data on price and the foreign supply elasticity to replicate the observed 1999 level of imports.

B.2 Demand for Brick and Structural Clay Products

Market demand for each structural clay product (Q^d) may be expressed as the sum of domestic and foreign demand:

$$Q^d = q^d + q^x \tag{B.7}$$

where q^d is the domestic demand and q^x is the foreign demand, or exports, as described below.

B.2.1 Domestic Demand

Domestic demand for each clay product may be expressed by the following general formula for each product:

$$q^d = B^d [p]^{\eta^d} \tag{B.8}$$

where p is the market price for the product, η^d is the domestic demand elasticity (assumed to be -1.5), and B^d is a multiplicative demand parameter that calibrates the demand equation for each product given data on price and the domestic demand elasticity to replicate the observed 1999 level of domestic consumption.

B.2.2 Foreign Demand (Exports)

Foreign demand, or exports, for each structural clay product may be expressed by the following general formula for each product:

$$q^x = B^x [p]^{\eta^x} \tag{B.9}$$

where p is the market price for the product, η^x is the export demand elasticity (assumed to be equal to -1.5), and B^x is a multiplicative demand parameter that calibrates the foreign demand equation for each product given data on price and the foreign demand elasticity to replicate the observed 1999 level of exports.

B.3 Post-Regulatory Market Equilibrium Determination

Facility responses and market adjustments can be conceptualized as an interactive feedback process. Facilities face increased production costs due to compliance, which causes facility-specific production responses (i.e., output reduction). The cumulative effect of these responses leads to an increase in the market price that all producers (affected and unaffected) and consumers face, which leads to further responses by producers (affected and unaffected) as well as consumers and thus new market prices, and so on. The new equilibrium after imposing the regulation is the result of a series of iterations between producer and consumer responses and market adjustments until a stable market price arises where total market supply equals total market demand ($Q^s = Q^d$).

This process for determining equilibrium price (and output) with the increased production cost is modeled as a Walrasian auctioneer. The auctioneer calls out a market price for each product and evaluates the reactions by all participants (producers and consumers), comparing total quantities supplied and demanded to determine the next price that will guide the market closer to equilibrium (i.e., where market supply equals market demand). Decision rules are established to ensure that the process will converge to an equilibrium, in addition to specifying the conditions for equilibrium. The result of this approach is a vector of prices with the proposed regulation that equilibrates supply and demand for each product.

The algorithm for deriving the post-compliance equilibria in all markets can be generalized to five recursive steps:

1) Impose the control costs on each affected facility, thereby affecting their supply decisions.

2) Recalculate the market supply of each structural clay product.

3) Determine the new prices via the price revision rule for both markets.

4) Recalculate the supply functions of all facilities with the new prices, resulting in a new market supply of each product. Evaluate market demand at the new prices.

5) Go to Step #3, resulting in new prices for each product. Repeat until equilibrium conditions are satisfied in all markets (i.e., the ratio of supply to demand is arbitrarily small for each product).

APPENDIX C

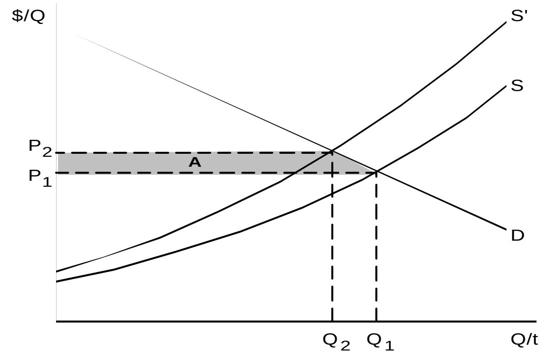
ESTIMATING CHANGES IN ECONOMIC WELFARE

The economic welfare implications of the market price and output changes with the regulation can be examined using two slightly different tactics, each giving a somewhat different insight but the same implications: (1) changes in the net benefits of consumers and producers based on the price changes and (2) changes in the total benefits and costs of these products based on the quantity changes. This analysis focuses on the first measure—the changes in the net benefits of consumers and producers. Figure C-1 depicts the change in economic welfare in a competitive market by first measuring the change in consumer surplus and then the change in producer surplus. In essence, the demand and supply curves previously used as predictive devices are now being used as a valuation tool.

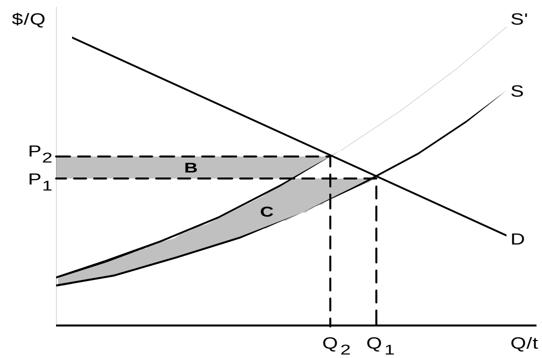
This method of estimating the change in economic welfare with the regulation divides society into consumers and producers. In a market environment, consumers and producers of the good or service derive welfare from a market transaction. The difference between the maximum price consumers are willing to pay for a good and the price they actually pay is referred to as "consumer surplus." Consumer surplus is measured as the area under the demand curve and above the price of the product. Similarly, the difference between the minimum price producers are willing to accept for a good and the price they actually receive is referred to as "producer surplus" or profits. Producer surplus is measured as the area above the supply curve and below the price of the product. These areas can be thought of as consumers' net benefits of consumption and producers' net benefits of production, respectively.

In Figure C-1, baseline equilibrium in the competitive market occurs at the intersection of the demand curve, D, and supply curve, S. Price is P_l with quantity Q_l. The increased cost of production with the regulation will cause the market supply curve to shift upward to

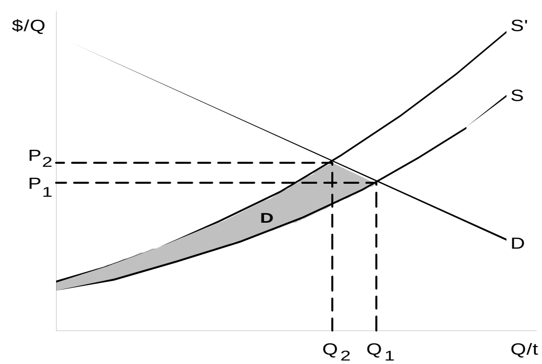
SN. The new equilibrium price of the product is P_2. With a higher price for the product, there is less consumer welfare, all else being unchanged as real incomes are reduced. In Figure C-1(a), area A represents the dollar value of the annual net loss in consumers' benefits with the increased price.



(a) Change in Consumer Surplus with Regulation



(b) Change in Producer Surplus with Regulation



(c) Net Change in Economic Welfare with Regulation

Figure C-1. Economic Welfare Changes with Regulation Under Perfect Competition

The rectangular portion represents the loss in consumer surplus on the quantity still consumed, Q_2, while the triangular area represents the foregone surplus resulting from the reduced quantity consumed, Q_1–Q_2.

In addition to the changes in consumer welfare, producer welfare also changes with the regulation. With the increase in market price, producers receive higher revenues on the quantity still purchased, Q_2. In Figure C-1(b), area B represents the increase in revenues due to this increase in price. The difference in the area under the supply curve up to the original market price, area C, measures the loss in producer surplus, which includes the loss associated with the quantity no longer produced. The net change in producer welfare is represented by area B–C.

The change in economic welfare attributable to the compliance costs of the regulation is the sum of consumer and producer surplus changes, that is, – (A) + (B–C). Figure C-1(c) shows the net (negative) change in economic welfare associated with the regulation as area D. However, this analysis does not include the benefits that occur outside the market (i.e., the value of the reduced levels of air pollution with the regulation). Including this benefit will reduce the net cost of the regulation, and may result in overall net positive benefits to society.